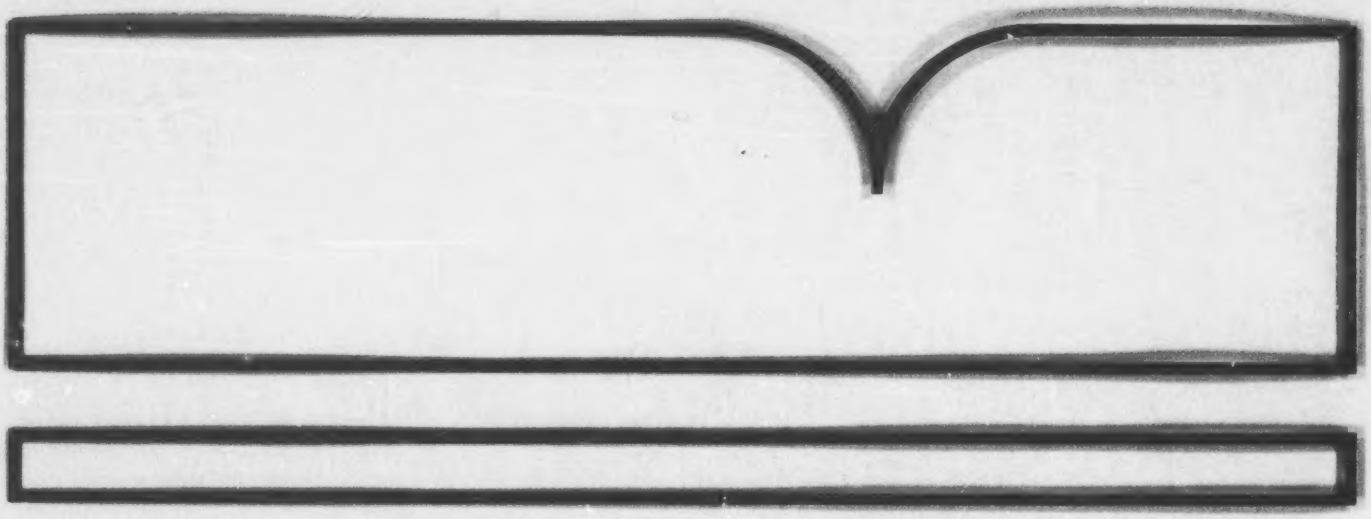
PB88-237482

Superfund Innovative Technology Evaluation Program Progress and Accomplishments

(U.S.) Environmental Protection Agency
Washington, DC

Feb 88



U.S. Department of Commerce
National Technical Information Service
NTIS

PB88-237482

United States
Environmental Protection
Agency

Office of Solid Waste and
Emergency Response
Washington DC 20460

Office of Research and
Development
Washington DC 20460

Superfund

EPA/540/5-88/001 Feb. 1988

EPA

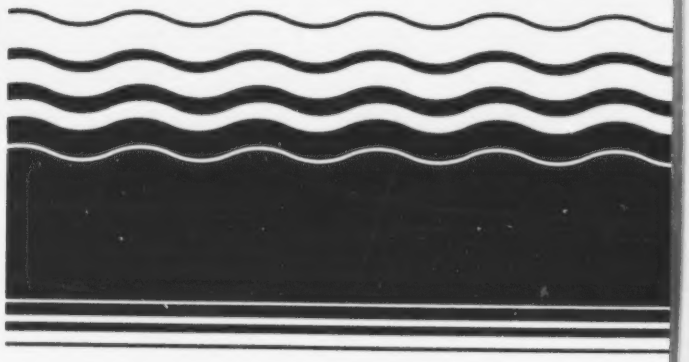
The Superfund Innovative Technology Evaluation Program:

Progress and Accomplishments

A Report to Congress

SITE

SUPERFUND INNOVATIVE TECHNOLOGY EVALUATION



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TECHNICAL REPORT DATA
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1. REPORT NO. EPA/540/5-88/001	2.
3. RECIPIENT'S ACCESSION NO. PB 88-237482	
4. TITLE AND SUBTITLE THE SUPERFUND INNOVATIVE TECHNOLOGY EVALUATION PROGRAM: Progress and Accomplishments--A Report to Congress	5. REPORT DATE February 1988
	6. PERFORMING ORGANIZATION CODE
7. AUTHOR(S)	8. PERFORMING ORGANIZATION REPORT NO.
9. PERFORMING ORGANIZATION NAME AND ADDRESS	10. PROGRAM ELEMENT NO.
	11. CONTRACT/GRANT NO.
12. SPONSORING AGENCY NAME AND ADDRESS Office of Solid Waste and Emergency Response U.S. Environmental Protection Agency Washington, DC 20460	13. TYPE OF REPORT AND PERIOD COVERED
	14. SPONSORING AGENCY CODE EPA-540/00

15. SUPPLEMENTARY NOTES

16. ABSTRACT

The Superfund Amendments and Reauthorization Act of 1986 (SARA) (Section 209(b)) amends Title III of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) by adding Section 311 which directs the Environmental Protection Agency to establish an "Alternative or Innovative Treatment Technology Research and Demonstration Program." Section 311(e) requires EPA to submit a report to Congress annually on the progress and results of this program. This report presents the program's accomplishments during Fiscal Year 1987 through January 30, 1988.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group

18. DISTRIBUTION STATEMENT RELEASE TO PUBLIC	19. SECURITY CLASS *(This Report)* UNCLASSIFIED	21. NO. OF PAGES 44
	20. SECURITY CLASS *(This page)* UNCLASSIFIED	22. PRICE A03 12.95

EPA Form 2220-1 (Rev. 4-77) PREVIOUS EDITION IS OBSOLETE

EPA/540/5-88/001
February 1988

THE SUPERFUND INNOVATIVE TECHNOLOGY EVALUATION PROGRAM

PROGRESS AND ACCOMPLISHMENTS

A Report to Congress

U.S. Environmental Protection Agency
Office of Research and Development
Office of Solid Waste and Emergency Response
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EXECUTIVE SUMMARY

The Superfund Amendments and Reauthorization Act of 1986 (SARA) (Section 209(b)) amends Title III of the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA) by adding Section 311 which directs the Environmental Protection Agency to establish an "Alternative or Innovative Treatment Technology Research and Demonstration Program." Section 311(e) requires EPA to submit a report to Congress annually on the progress and results of this program. This report presents the program's accomplishments during Fiscal Year 1987 and through January 30, 1988.

In response to SARA, EPA created the Superfund Innovative Technology Evaluation (SITE) Program. The SITE Program is intended to 1) accelerate the development, demonstration and use of new or innovative treatment technologies and 2) demonstrate and evaluate new, innovative measurement and monitoring technologies.

During FY 1987, the SITE Program established a Demonstration Program, Measurement and Monitoring Techniques Development Program, and a Technology Transfer Program.

Demonstration Program. The demonstration and evaluation of technologies developed by private industry have been the primary activities of the SITE Program in FY 1987. The major objective of the demonstration program is to develop reliable performance and cost information of the technologies selected so that they can be adequately considered in Superfund decision making. Demonstrations take place at Superfund sites or under conditions that either duplicate or closely simulate wastes and conditions found at Superfund sites. At the close of FY 1987, 20 developers had been selected to participate in the program, ten in each of two solicitation cycles.

Measurement and Monitoring Techniques Development Program. The Environmental Monitoring Systems Laboratory in Las Vegas, Nevada, has been supporting the development of two monitoring/measurement techniques under the SITE Program: immunoassays for toxic substances and fiber optic sensing for in situ analysis at Superfund sites.

Technology Transfer Program/ Clearinghouse. SARA requires that an information dissemination program be established in conjunction with the SITE Program. During FY 1987, EPA designed a Clearinghouse for information on the SITE Program and other related information on alternative hazardous waste treatment technologies. The Clearinghouse includes a hotline, an electronic bulletin board/computerized data network, and a reference library of relevant reports, books, and articles.

In FY 1988, the SITE Program will continue the programs described above, and will expand to several new areas. An Emerging Technologies Program will be initiated to support technologies that are not yet ready for demonstration but show high potential for successful transition from conceptual to demonstration stage. The solicitation for this program has already been announced and developers will be selected by Spring 1988. Another new initiative in FY 1988 will be the Innovative Development and Evaluation Program which will accelerate the development of alternative technologies developed by EPA's Office of Research and Development.

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I. INTRODUCTION

STATUTORY AUTHORITY

The Superfund Amendments and Reauthorization Act of 1986 (SARA) (Section 209 (b)) amends Title III of the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA) by adding Section 311 which directs the Environmental Protection Agency to establish an "Alternative or Innovative Treatment Technology Research and Demonstration Program" and to submit a report to Congress annually on the progress and results of this program. As required in Section 311(e), this report presents the program's accomplishments during Fiscal Year 1987 and through January 30, 1988.

In response to SARA, EPA has established a formal program to 1) accelerate the development, demonstration and use of new or innovative treatment technologies, and 2) demonstrate and evaluate new, innovative measurement and monitoring technologies. This program is called the Superfund Innovative Technology Evaluation (SITE) Program.

The overall goal of this program is to "carry out a program of research, evaluation, testing, development, and demonstration of alternative or innovative treatment technologies . . . which may be utilized in response actions to achieve more permanent protection of human health and welfare and the environment." SARA defines "alternative technologies" as "those technologies, including proprietary or patented methods, which permanently alter the composition of hazardous waste through chemical, biological, or physical means so as to significantly reduce the toxicity, mobility, or volume (or any combination thereof) of the hazardous waste or contaminated materials being treated. The term also includes technologies that characterize or assess the extent of contamination, the chemical and physical character of the contaminants, and the stresses imposed by the contaminants on complex ecosystems at sites." Under the SITE Program, alternative technologies are categorized by their development status as follows:

- *Available Alternative Technology*. Technologies, such as incineration, that are fully proven and in routine commercial or private use.
- *Innovative Alternative Technology*. Any fully-developed technology for which cost or performance information is incomplete, thus hindering routine use at hazardous waste sites. An innovative alternative technology requires full-scale field testing before it is considered proven and available for routine use.
- *Emerging Alternative Technology*. An emerging technology is one in an earlier stage of development; the research has not yet successfully passed laboratory- or pilot-scale testing.

The SITE Program assists technology developers in the development and evaluation of new and innovative treatment technologies, and thus enhances the commercial availability and use of these technologies at Superfund sites as alternatives to land-based containment systems presently in use. The program consists of the following major initiatives:

- Conduct and monitor demonstrations of promising innovative technologies to provide reliable performance and cost

information for future site characterization and cleanup decision making.

- Identify and remove informational impediments to the use of alternative technologies.
- Develop procedures and policies that encourage the use of alternative treatment remedies at Superfund sites.
- Encourage the development of emerging technologies.

Section 121(b) of SARA states a preference for treatment technologies that permanently reduce the volume, toxicity or mobility of the hazardous waste. Section 209(b) of SARA authorizes EPA to use hazardous waste from or representative of Superfund sites for alternative technology research and demonstrations.

The SITE Program also supports the testing and development of improved monitoring and measurement technologies to be used at Superfund sites. This component of the program is intended to improve capabilities in site assessment, measuring the extent of contamination, as well as measuring the effectiveness of a selected remedy.

Recognizing that access to accurate, pertinent information is essential to the acceptance of alternative technologies, Section 311(b)(8) also directs EPA to ". . .conduct a technology transfer program including the development, collection, evaluation, coordination, and dissemination of information relating to the utilization of alternative or innovative treatment technologies for response actions. . ." The statute requires the Agency to establish and maintain a central reference library for such information. As described later in this report, EPA has established a clearinghouse to ensure that program findings, as well as other treatability data, will be available to the Agency and other interested parties.

This report documents the progress made prior to the enactment of SARA during Fiscal Year 1987 and during the first quarter of Fiscal Year 1988. It also summarizes activities planned for the remainder of Fiscal Year 1988. The report includes the following:

- An overview of the development of the program and its components.
- A description of the process used for the technology demonstration program.
- A description of progress made by the program to date.
- An outline of activities for 1988.

HISTORICAL PERSPECTIVE

Prior to the enactment of SARA, concern had been growing among the scientific community, citizens, and government officials over the effectiveness and cost of conventional methods for handling hazardous wastes at Superfund sites. Over the past few years, it has become evident that land disposal is not the best solution for much of the hazardous waste present at these sites. The need for long-term, reliable, low cost treatment solutions has been stressed by studies and legislation:

- The Hazardous and Solid Waste Amendments of 1984 (reauthorization of the Resources Conservation and Recovery Act) imposed prohibitions on land disposal of certain hazardous wastes. These restrictions will require treatment of many Superfund wastes that previously may have been placed untreated into land disposal units.
- A 1985 report by the U.S. Congress, Office of Technology Assessment (OTA) highlighted concerns with land disposal of hazardous wastes. It concluded that while land disposal is a proven technology for nonhazardous wastes, it is not a long-term solution to our hazardous waste problems, and that the long-term costs of land disposal may be quite high when the costs of monitoring, operation and maintenance, and possible future cleanup action are considered.

The scientific and engineering communities recognized that the demand for treatment often outstripped the availability and capability of

existing technologies. OTA concluded in its report that research, development, and demonstration (RD&D) devoted to innovative cleanup technologies were inadequate. The Science Advisory Board also recommended embarking on a comprehensive research program to identify more effective, permanent solutions. However, the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA) directed that Superfund resources be used only to support activities directly related to site cleanups, and prohibited the use of funds for R&D.

In response to these growing concerns, EPA moved ahead in early 1986 to develop a technology demonstration program within the existing statutory and budgetary authority provided by the Hazardous and Solid Waste Amendments of 1984. A strategy was developed to lay out the problems, impediments, and possible solutions relative to the increased use of innovative treatment technologies at Superfund sites. EPA convened a review group composed of experts from large and small companies, academia, State governments, environmental groups, and consulting engineering firms to review and help develop this strategy. The review group provided much of the rationale for developing a technology demonstration program, citing the need for an objective evaluation of new technologies being marketed to the EPA Regional Offices and States for cleanup efforts.

EPA advertised its first solicitation for innovative treatment technology demonstration proposals in the *Commerce Business Daily* on February 13, 1986. This solicitation attracted 20 proposals ranging from containerization to incineration to robotics. In addition, EPA invited developers of promising technologies that were already involved in hazardous waste/Superfund demonstrations or cleanup activities to participate in the program. EPA staff also evaluated unsolicited proposals that were submitted to EPA during the Spring and Summer of 1986.

As a result of this initial work on the program, when SARA was enacted in October 1986, EPA was able to respond with a program that was already in the planning stages, although funding had not been available.

SITE PROGRAM COMPONENTS

There are a number of obstacles inhibiting the acceptance and use of alternative technologies for the treatment of hazardous wastes at Superfund sites. These technologies often have not had the opportunity to be proven effective on a commercial scale or have not been used for specific applications at hazardous waste sites. As a result, it is difficult to assure potentially responsible parties, site owners, and the affected community that technologies which have not undergone full-scale demonstration will be effective in remediating a site. A key component of the SITE Program is the removal of these informational impediments, by supporting demonstrations that will provide reliable performance and cost data.

To foster this comprehensive program for the development and acceptance of new and improved technologies, the SITE Program includes several components. These include the following:

- *Demonstration Program.* The demonstration and evaluation of technologies developed by private industry have been the primary activities in the first year of the program (Fiscal Year 1987). As part of a cooperative agreement between the technology developers and EPA, the developers provide and operate the technology, and EPA conducts sampling and analysis. Evaluations normally take place at a Superfund site, EPA Test and Evaluation facility, or the developer's site.
- *Emerging Technologies Program.* In Fiscal Year 1988 EPA will assist private industry in the development of emerging technologies from the conceptual stage to pilot-scale demonstration through cost-sharing agreements. It is anticipated that these projects will take place at the developer's facility or at an EPA Test and Evaluation Facility.

- *Innovative Development and Evaluation.* EPA R&D staff have been active in the development of new technologies which show potential for application at Superfund sites but where the private sector is not actively pursuing these applications. This program will accelerate the development and demonstration of these technologies by quickly moving them to the field demonstration stage.

- *Measurement and Monitoring Techniques Development.* EPA laboratories are exploring technologies that will permit improved assessment of the extent of contamination, characterization of contaminants, and evaluation of remedial/ removal activities at hazardous waste sites.

- *Technology Transfer Program.* Dissemination of data from demonstrations conducted under the SITE Program is the key to increasing the use of alternative technologies at Superfund sites. EPA has designed and will be implementing a clearinghouse for information relevant to the SITE Program.

The SITE demonstration program is the major objective of SITE and the first component to be fully implemented. The other components will be fully implemented in 1988 and 1989.

II. THE SITE DEMONSTRATION PROGRAM

Based on the emphasis placed on demonstrations in Section 311(b) of CERCLA, the demonstration program has been the primary focus of the SITE Program. The major objective of the demonstration program is to develop reliable performance and cost information on innovative alternative technologies so that they can be adequately considered in Superfund decision making. The demonstrations are designed to provide sufficient information to enable potential users to make sound judgments as to the applicability of the technology for a specific site and to compare the technology's effectiveness and cost to other alternatives. The results of the demonstrations identify the limitations of the technology, the potential need for pre- and post-processing of wastes, the types of wastes and media to which the process can be applied, the potential operating problems, and the approximate capital and operating costs. The demonstrations also permit evaluation of long-term operating and maintenance costs and long-term risks. Demonstrations take place at Superfund sites or under conditions that duplicate or closely simulate actual wastes and conditions found at Superfund sites to assure the reliability of the information collected and acceptability of the data by users.

EPA has developed implementation procedures to ensure that the demonstration program facilitates developer participation, gathers required data, and provides adequate safeguards for human health and the environment. This implementation process includes the following major steps:

- Selection of technologies and developers for participation.
- Selection of sites for the demonstrations.
- Development of cooperative agreements with developers.
- Development and implementation of community relations activities.
- Preparation of detailed plans for the demonstration.
- Conduct of the demonstration.
- Preparation of reports on the demonstration results.

The procedures developed and the activities that have been performed under each of these steps are discussed in the following sections.

SELECTION OF TECHNOLOGIES

The solicitation and selection processes developed by EPA for the SITE Program are designed to ensure that all technologies that are potentially useful for cleaning up Superfund sites are identified and screened, that those with the most potential are selected for demonstration, and that all developers have access to the program.

The primary method used by EPA to identify privately-developed technologies for potential demonstration is advertisement of the annual solicitation in the *Commerce Business Daily*. In response to the solicitation, technology developers submit proposals to EPA addressing the following selection criteria:

- Technology Factors: description of the technology and its history; identification of effective operating range; application to hazardous waste site cleanup; mobility of equipment; capital and operating costs; advantages over existing comparable

technologies; and identification of health, safety, and environmental problems.

- Capability of the Developer: development of other technologies; completion of field tests; experience, credentials, and assignment of personnel; and capability to commercialize and market technology.
- Approach to Testing: operations plan; materials and equipment; range of testing; health and safety plan; monitoring plan; quality assurance plan; assignment of responsibilities; backup treatment system plan; and regulatory compliance plans.

Two solicitation cycles have been completed. These have been titled SITE 001 and SITE 002.

Selection of Site 001 Demonstration Projects

In response to the first solicitation in the *Commerce Business Daily* in February 1986, EPA received approximately 450 requests for the SITE Program Request for Proposal (RFP). The RFP was made available on March 15th and the deadline for responses was April 25th. EPA reviewed a total of 20 proposals by May. None of the proposals was considered fully acceptable. The proposals were categorized as "conditionally acceptable," "rewrite," or "not acceptable." Those that were considered "conditionally acceptable" had either technical or administrative issues that needed to be addressed by the technology developer. The "rewrites" required more extensive revision. Those that were "not acceptable" offered unproven containment technologies, failed to submit sufficient technical data, or provided only bench-scale data.

In early July 1986, EPA notified the developers of their proposal status. Conditionally acceptable and rewritten proposals were due for resubmission in August. After reviewing the responses, the following six vendors were considered acceptable:

- American Combustion, Inc. (PYRETRON Oxygen-Air-Fuel Burner)
- Hazcon, Inc. (Solidification/ Stabilization Process)
- Shirco Infrared Systems, Inc. (Infrared Thermal Destruction)
- Terra Vac, Inc. (In situ Vacuum Extraction)
- Waste-Tech Services, Inc. (Fluidized Bed Combustion)
- Westinghouse Electric Corporation (Electric Pyrolyzer System and Pyroplasma System)

A second method used by EPA to identify SITE Program participants focused on conducting evaluations of alternative technologies that were in current use at Superfund sites during routine response actions associated with both removal and remedial activities. Several projects were identified through this method, including:

- The Haztech, Inc.-owned Shirco Infrared Systems Unit at the Peak Oil Superfund site in Brandon, Florida.
- Resources Conservation Company's Basic Extraction Sludge Technology demonstration at the General Refining Superfund site in Savannah, Georgia.
- New York State Department of Environmental Conservation Plasma Arc Unit demonstration at Love Canal, New York.
- Ogden Environmental Services Circulating Fluidized Bed Combustor on waste from California Superfund sites.
- International Waste Technology In Situ Stabilization/Solidification Process at the General Electric site in Hialeah, Florida.
- Detox Industries, Inc. Biological Degradation Process at a Texas site.

In July, 1987, Waste-Tech Services, Inc., notified EPA that they were withdrawing from the program due to indemnification issues. At a future date, Waste-Tech may decide to participate further in the SITE Program.

Selection of Site 002 Demonstration Projects

On January 15, 1987, EPA sent approximately 400 Requests for Proposal (RFP) for the SITE 002 cycle to private developers who expressed an interest in becoming involved with the program. The SITE 002 solicitation differed from the SITE 001 program in that the 002 program included requests for pilot-scale technologies as well as those at demonstration scale. Responses to the RFP were due by March 13, 1987. Twenty-nine proposals were received and were reviewed by a panel of EPA experts. The review panel determined that:

- Twelve were not acceptable.
- Three were incomplete because they did not specifically address the RFP and its criteria. They were asked to submit a complete proposal.
- Two were asked to rewrite their proposals.
- Twelve were considered conditionally acceptable and were asked to clarify issues or submit additional information.

On June 12, 1987, a letter was sent to all 29 developers notifying them of the results of the review. All but the 12 "not acceptable" applicants were asked to address specific questions or provide information pertaining to their technologies.

The twelve proposals that were rejected involved technologies that were already proven as a viable alternative, or technologies that did not meet the definition of an "alternative technology."

As a result of this process, the following developers were selected for participation in the SITE Program and notified in September 1987:

Thermal Technology

- Retech, Inc.

Extraction Technology

- C.F. Systems Corporation

Solidification/Stabilization Technology

- Soliditech, Inc.
- Chemfix Technologies, Inc.
- Waste Chem Corporation
- Battelle Pacific Northwest Laboratory

Ion Exchange Technology

- Sanitech, Inc.

Biological Technology

- Air Products and Chemicals, Inc.
- Zimpro Environmental Control Systems
- MoTec, Inc.

SELECTION OF DEMONSTRATION SITES

Once EPA has evaluated the technology proposals and notified the developers of their acceptance into the SITE Program, the demonstration site selection process is initiated. Potential SITE demonstration locations include Federal and State Superfund removal and remedial sites, EPA research facilities, sites from other Federal agencies, and developers' sites.

The criteria used to screen and select candidate sites for target demonstrations include the following:

- Compatibility of waste with technology
- Volume of waste
- Variability of waste
- Availability of data characterizing waste
- Accessibility of waste (i.e., degree of excavation required)
- Applicability of demonstration to site cleanup efforts
- Availability of required utilities (i.e., power and water sources, sewers)
- Support of community, State and local governments, and potentially responsible parties
- Potential for adverse effects to public health and the environment.

In October 1986, each of EPA's Regional Offices nominated Superfund sites for the demonstration of the following SITE 001 demonstration projects that were brought into the program through the solicitation process:

- Shirco Infrared Systems, Inc.'s Infrared Thermal Destruction
- Hazcon, Inc.'s Solidification/Stabilization
- Westinghouse Electric Corporation's Electric Pyrolysis System and Pyroplasma System
- Terra Vac's In situ Vacuum Extraction

A site was not requested for American Combustion, Inc. since EPA's Combustion Research Facility was selected for the demonstration of its PYRETRON burner.

The Regional Offices submitted information on the type of waste(s) for which the technology is appropriate and additional desirable site characteristics, as provided by the developers. They also included a statement explaining why the site was chosen.

Nineteen Superfund sites were nominated for consideration by the EPA Regional Offices. The sites were characterized by EPA Headquarters in terms of a general description, contaminants and media present, status of Superfund remediation, presence of utilities, and access considerations. The strengths and weaknesses of each site were compiled based on considerations and preferences provided by the developer and four principal program goals. These goals include:

- Production of the most useful information on each technology's capabilities.
- Expeditious implementation.
- Production of information relevant to the specific site cleanup efforts.
- Involvement of as many EPA Regions as possible in the SITE Program.

EPA staff worked extensively with the technology developers to obtain additional information needed to match potential sites with the technologies. EPA also coordinated with the Department of Energy to identify possible sites for technologies for which no Superfund site was nominated. During the Spring of 1987, as sites were tentatively selected, a series of kick-off meetings were held for each project to acquaint the technology developer with appropriate EPA and State officials. Visits were made to inspect and confirm site access, physical layout, and other factors. The site selections that resulted from this process, or from current cleanup or research activities, are listed below and are described in further detail in Chapter III.

- American Combustion, Inc. -- The EPA Combustion Research Facility in Jefferson, Arkansas is treating contaminated soil from the Stringfellow Acid Pit Superfund site in California.
- Detox Industries, Inc. -- A Superfund site in Conroe, Texas is being negotiated.
- Hazcon, Inc. -- Douglassville Disposal Superfund site in Union Township, Berks County, near Douglassville, Pennsylvania.
- Haztech, Inc./Shirco Infrared Systems, Inc. -- Peak Oil Superfund site in Brandon, Florida.
- International Waste Technologies -- General Electric site in Hialeah, Florida.
- New York State Department of Environmental Conservation -- Love Canal in New York.
- Ogden Environmental Services -- Ogden facility in San Diego, California will treat wastes from the Stringfellow Superfund site and the McColl Superfund site in Fullerton, California.
- Resources Conservation Company -- no site selected yet.
- Shirco Infrared Systems, Inc. -- Rose Township-Demode Road Superfund site in Michigan.
- Terra Vac, Inc. -- Groveland Wells Superfund site in Groveland, Massachusetts.
- Westinghouse Electric Corporation -- no sites selected yet.

EPA is in the process of selecting sites for SITE 002 demonstration projects.

NEGOTIATION OF COOPERATIVE AGREEMENTS

In order to implement the SITE demonstration program, SARA has authorized the Agency to enter into grants, contracts and cooperative agreements. Applicants whose technologies are selected through the solicitation process negotiate with the Agency to determine the degree of cost sharing, if any, and the conditions of the agreement.

Usually, the developer bears the demonstration costs of building, locating on-site, operating, and dismantling cleanup equipment. EPA assists the developer with permit acquisition and pays the costs associated with sampling and analysis, quality assurance and control, evaluating the data, and preparing summary reports. Thus, the EPA contribution reduces the actual cost of a demonstration project to the developer.

Section 311(b)(5) permits EPA to fund up to 50% of the developer's cost of a SITE demonstration project, if the developer shows that it cannot obtain appropriate private financing on reasonable terms sufficient to carry out the project without Federal assistance. EPA can provide no more than $3 million total for any single project and no more than $10 million total in any one year for such assistance. EPA's guidelines for financial assistance were announced in January 1988 in the SITE 003 solicitation. Developers selected for the SITE Program that desire assistance will be required to show that a good faith effort has been made to obtain financing and that a financial need exists.

COMMUNITY RELATIONS ACTIVITIES

A well-planned community relations effort is an integral part of the Superfund program, including the SITE demonstration program. In fact, Section 311(b)(5) requires the establishment of a public notice and comment period prior to the final selection of a SITE demonstration site. The objective of this community relations program is to actively encourage two-way communication between communities affected by releases of hazardous substances and government agencies responsible for cleanup action. The program enables local citizens to have input to decisions regarding cleanup actions so that planning reflects public concerns. At the same time, the community relations program ensures that the community is provided accurate and timely information about cleanup plans and progress.

In designing a community relations program for a particular SITE demonstration, EPA focuses on the special concerns of the community. The Agency has noted that the amount of information available on the operation of each technology affects the degree and nature of public concern. For example, some communities are concerned with the developmental, unproven aspect of the technology and may oppose the demonstration. Other communities may support a demonstration irrespective of limited data because of their belief that the demonstration represents progress in cleaning up the site. Some communities may be concerned with potential increased health risks posed by possible failure of the technology demonstration.

To address these and other concerns, community relations activities occur during all phases of the SITE Program. Activities began during the first site selection process and have continued through actual demonstrations. EPA has prepared and distributed site-specific technology fact sheets, published notices in local newspapers, and held public meetings. Each Regional Community Relations Office has been encouraged to hold at least one informational briefing or public meeting in the community. Public meetings have been held in Brandon, Florida; Rose Township, Michigan; Douglassville, Pennsylvania; Groveland, Massachusetts; and Love Canal, New York. Public reaction at these meetings has generally been supportive of the proposed demonstrations.

Communication with the community continues during the actual demonstrations. It may include site tours, workshops, an on-scene information office, community meetings, and status reports. A summary of the demonstration results and the final report are made available to the community.

Specific activities have varied for each demonstration. A more detailed description of community relations activities associated with each demonstration project is included in Chapter III.

DEMONSTRATION PLANNING PROCESS

After technologies and sites are selected, the next step in the process is development of a detailed design of the technology demonstration, testing, and evaluation program. The design includes specifications for all activities needed to ensure that the information objectives of the program are met. For each demonstration, the following must be addressed by the developer and EPA:

- *Evaluation program duration and schedule.* The duration of the testing program needed to sufficiently demonstrate and evaluate the technology, including estimates of the time required for test preparation, performance, equipment dismantling, and technical evaluation preparation.
- *Site requirements.* Utilities, certain types of test materials (i.e., contaminated liquids, soils, or sludges); land area for setup; legal access to the land; proximity to support facilities (i.e., machine shops); geographical or geological restrictions; personnel support; security provisions; and personnel safety provisions.
- *Detailed evaluation design.* Operating conditions outside of and within the expected operating range; all operating and control variables and their full range of settings; the expected influence on the performance of each variable, including a sensitivity analysis for each variable; measurements to be taken during the experiment; calibration of all measuring equipment, exclusive of sampling points with samples of calibration curves from previous activities; proposed information for nonmeasurement-related operating conditions; data from previous experiments; detailed operating log sheets that identify operating problems, system weaknesses, safety problems, and other pertinent operating information; all logistics and support requirements, including the number and training levels of operating personnel, specific utility requirements, and other support information as given in the site logistics requirements identified above.
- *Sampling and analytical program.* To provide data adequate to support the claims for the proposed technology and to evaluate its effectiveness.
- *Quality assurance/ quality control (QA/QC) program.* QA/QC is a critical element of each SITE demonstration because QA/QC procedures ensure that data are of known and acceptable quality for their intended use. There are three separate tasks pertaining to the QA/QC activities:
  - *QA/QC Audit of the Proposed Technology Testing Facility.* A QA/QC audit of the technology testing facility is performed by EPA. Where the developer's facility is used, the developer makes the facility available to be audited by EPA and/or EPA contractor(s) and provides appropriate assistance to them. The developer agrees to upgrade the testing facility as necessary based upon the outcome of the audit. A QA/QC audit is performed when sampling is implemented at the site as well as an audit at the laboratory when the samples are analyzed.
  - *Preparation of a QA/QC Program Plan.* EPA prepares a QA/QC program plan covering general QA/QC goals for all evaluation projects. This plan serves as a coordinating and format guide document for the specific QA/QC project plans prepared for each technology evaluation project.
  - *Preparation and Implementation of a Written QA/QC Project Plan.* Preparing and implementing a QA/QC project plan is the responsibility of EPA with assistance from the developer. This plan identifies QA/QC goals specific to the evaluation of the developer's

technology and is in accordance with EPA established requirements and procedures for all QA/QC activities.

- *Health and safety requirements*. A coordinated health and safety plan contains the following elements:
  - Provisions for medical monitoring of operating and management personnel, if necessary.
  - Safety training for personnel who will be in restricted zone.
  - Level of worker protection (classification of outergarments as a function of the type of exposure).
  - Establishment of zones of safety; "clean area" establishment and movement restrictions in various zones.
  - Decontamination of personnel outergarments and equipment.
  - Emergency procedures.
  - Supervision responsibilities.

Seven demonstration plans have been completed.

PROGRAM OUTPUTS

There are two major outputs for each demonstration. The first is a technical report documenting the performance data resulting from the demonstration. The report includes testing procedures, data collected, and QA/QC conducted. It summarizes the results in terms of performance (effectiveness and reliability) and cost. The report also addresses issues such as applicability, pre- and post-treatment requirements, and advantages/disadvantages compared to available technologies. EPA is responsible for distribution of the report following review and approval. The first such report, from Haztech, Inc.'s demonstration of the Shirco Infrared System at the Peak Oil site in Brandon, Florida, is scheduled to be completed in Spring, 1988.

Successful demonstration of a technology at one Superfund site does not, by itself, imply that the technology will be adopted for full-scale use at other Superfund sites. To enable and encourage the general use of demonstrated technologies, EPA prepares a second report that evaluates the applicability of each technology to other sites and wastes, and provides cost estimates for these applications. This information will then be disseminated to potential users in the form of an Applications Analysis Report. The Applications Analysis Report for each technology will be available approximately two months after the first performance data report.

The development and reporting of cost data for the demonstrated technologies is a difficult issue. Specific site and waste characteristics have a significant impact on costs. In some cases, the SITE demonstration period comprises only a portion of the time a process is in operation at a site. For purposes of the two reports described above, a protocol for evaluating SITE demonstration costs has been developed and will be applied to all projects. The SITE cost protocol makes use of both the raw variable cost data collected during the demonstration, as well as the developer's specific baseline cost data. By allowing the developer to specify his underlying cost structure, the Agency precludes the possibility of misrepresenting the cost to potential customers. A balance is provided by critically analyzing the developer's costs in light of the demonstration experience. These costs can then be placed within a competitive range of similar processes. The reader will then be able to draw a more complete picture of the potential costs given a particular sites' characteristics.

The dissemination of information on the performance of technology demonstrations and applications of the technologies is crucial once results from demonstration projects are available. If alternative technologies are to be applied more broadly at Superfund sites, Agency personnel, engineers, and others must have access to reliable technical information. Thus, the technology transfer/ clearinghouse component of the SITE Program is intended to provide technical information from the SITEdemonstrations to interested parties in a timely manner. Details on the overall approach to technology transfer in the SITE Program are given in Chapter III.

III. FIRST YEAR PROGRESS AND ACCOMPLISHMENTS

During the first year of the SITE Program (Fiscal Year 1987), EPA focused on establishing the processes and procedures needed to implement the program and initiate activity in several program components. Specifically, the following were accomplished in FY 1987:

Demonstration Program

- SITE 001 - Twelve technologies were selected for demonstrations; sites have been selected for nine of the technologies; three demonstrations have been completed; and two more are underway.
- SITE 002 - Ten developers have been selected to conduct alternative technology demonstrations and the site selection process is underway.

Measurement and Monitoring Techniques Development

Support was provided to the development of the following two technologies:

- Immunoassays for toxic substances
- Fiber optic sensing for in situ analysis

Technology Transfer/Clearinghouse

A long-term technology transfer strategy was developed and a clearinghouse was established that included:

- A hotline
- An electronic bulletin board
- A collection of reports, journals and other pertinent documents

Progress and accomplishments in each of these three areas are described in the sections that follow.

DEMONSTRATION PROGRAM

During the first year of the SITE Program, the demonstration program followed the process outlined in the previous chapter. While it took time to establish the new process, the developers and EPA have made considerable progress. In addition, the experience of the first year has contributed lessons that will enable EPA to move more rapidly in subsequent years of the program. Descriptions of each of the SITE 001 and SITE 002 demonstration projects follows.

Site 001 Demonstration Project Descriptions

Shirco Infrared Systems, Inc.

Technology

The Shirco Infrared Thermal Destruction System is a transportable thermal treatment unit (See Figure 1). The Shirco process uses rows of electrically-powered silicon carbide rods to bring the waste to combustion temperatures. Remaining combustibles are destroyed in an afterburner.

The full-scale four-component system can process from 100 to 250 tons of waste per day, depending on the waste characteristics. The first component, the primary furnace, is lined with layers of lightweight ceramic fiber blanket insulation. The furnace generates temperatures up to 1850°F using infrared radiant heat provided by horizontal rows of silicon carbide rods (located above the conveyor belt). Waste moves through the primary furnace on a woven

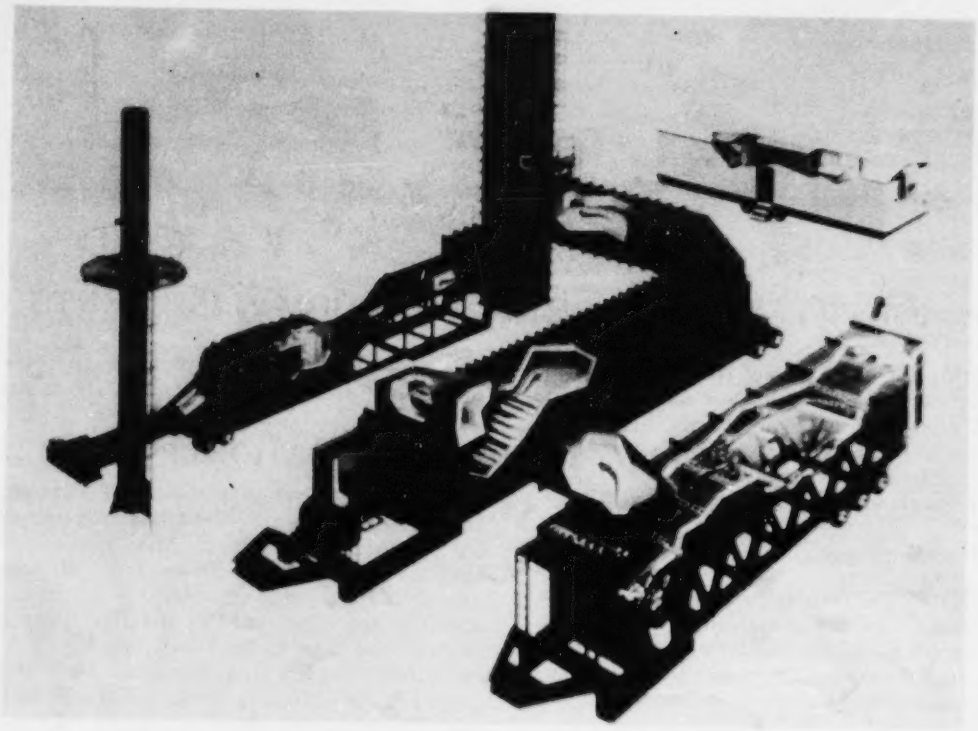

Figure 1. Transportable Infrared Thermal Unit

wire mesh belt. The second component, an infrared or gas-fired secondary combustion chamber, is capable of reaching temperatures up to 2300°F. The secondary chamber destroys gaseous volatiles from the primary furnace. The third component consists of an emissions control system which removes particulates in a venturi scrubber. Acid vapors are neutralized in a packed tower scrubber, and an induced draft blower draws cleaned gases from the scrubber into the exhaust stack. The fourth component consists of a process management and monitoring control center.

Progress and Accomplishments

Shirco Infrared Systems, Inc., is participating in two demonstrations.

Demonstration One. Full-Scale System

Site Selection. EPA contracted with Haztech, Inc., of Atlanta, Georgia, to incinerate approximately 7,000 cubic yards of waste oil sludge contaminated with polychlorinated biphenyls (PCBs) and lead. In November 1986, Haztech began setting up a full-scale, mobile thermal processing system, owned by Haztech but manufactured by Shirco Infrared Systems, Inc. In early 1987, the SITE Program sought to include this technology in the demonstration program and to monitor and evaluate the performance of this system during the cleanup operation.

Community Relations. As part of community relations activities for the removal action, EPA distributed a notice to the local community of the upcoming action and held an openhouse at the town hall. The public

expressed little interest in the planned removal activities.

Demonstration Status. The first SITE demonstration involving Haztech, Inc.'s Shirco Infrared System was conducted at the Peak Oil Superfund site in Brandon, Florida, on July 31 through August 5, 1987, during a removal operation by EPA Region IV.

In February 1987, SITE contractors began preparing a demonstration plan, which included the test and quality assurance plans. The main components of the demonstration were to evaluate the reliability of the performance of the unit for the destruction of PCBs and validate the manufacturer's claim that the lead compounds could be converted from a soluble to an insoluble form by the Shirco process. In addition to the standard trial burn tests, the demonstration would attempt to establish a material balance for the unit, identify products of incomplete combustion (PICs), and assess reliability and operational factors.

By June, the unit was operating at approximately 100 tons per day and was ready for performance testing. The on-site demonstration and testing of the infrared system began on July 31 and continued through August 5, 1987. EPA SITE staff and contractors were present to observe and collect data. During the week, the SITE project team conducted a trial burn (three 8-hour runs), and extensive sampling, including solid waste feed, stack gas, furnace ash, scrubber liquid effluent, scrubber water influent, scrubber effluent solids, and ambient air. All operating conditions during the runs were documented. By mid-October, the phase of the removal action involving the use of the infrared system was completed. A total of 7,000 cubic yards of waste material had been processed.

In addition to the sampling data described above, the report on the demonstration will document the entire mechanical operating history of the system and the problems encountered in operating this type of full-scale system. This documentation should be particularly useful to other users of innovative technologies. A final technical report on the demonstration is scheduled to be completed in Spring, 1988.

Demonstration Two. Pilot-Scale System

Site Selection. The pilot-scale infrared destruction system is a portable one-ton per day version of the system described above, housed in one trailer. The site identified for the evaluation of the portable pilot-scale Shirco unit was the Rose Township - Demode Road Superfund site in Michigan. The Rose Township dump site is a 20-acre site used to bury and dump drums of various solvents and paint sludges. The drums were removed in 1980, but the contaminated soil contains high concentrations of organics, PCBs, and metals, principally lead. EPA chose the Rose Township site for the following reasons:

- Successful destruction of PCB-containing waste provides a good indication of thermal destruction efficiency.
- The Michigan Department of Natural Resources, which has the lead for site cleanup, is interested in determining the fate of metals in thermal treatment systems.
- The draft feasibility study identified thermal treatment as a potential remedy; therefore, the demonstration will have direct application to the final cleanup remedy selection. (The Record of Decision has since selected thermal destruction).

In addition, it is anticipated that this demonstration was intended to determine whether the treatment will fuse the lead in the waste to the ash, thus reducing the potential for lead leaching out of the ash over time and the potential for lead emissions in the stack gas.

During the development of the demonstration plan, EPA worked with the Michigan Department of Natural Resources (DNR) to identify all regulatory requirements that apply to this demonstration. The Michigan Air Pollution Control Commission issued a permit to Shirco Infrared Systems, Inc. to proceed with the test program for the Shirco unit. The Michigan DNR waived the requirement for hazardous waste construction

and operating permits based, in part, on the short duration of the test.

Community Relations. On June 30 and July 1, 1987, the State of Michigan held an open house, followed by a public meeting on both the planned demonstration and the draft feasibility study for the Superfund cleanup. Approximately 30 townspeople attended and expressed general support for the demonstration. The public comment period ended on July 29, 1987, with no serious issues raised. EPA performed an environmental review and the State of Michigan reviewed the project through the intergovernmental review. Thus, EPA and the Michigan Department of Natural Resources decided to proceed with the planned demonstration in the Fall of 1987. Public visitors' days were held on October 31 and November 4, 1987.

Demonstration Status. The demonstration took place November 2-13, 1987. The pilot-scale infrared thermal destruction unit treated about ten cubic yards of contaminated soil. The project utilized a blend of the most highly PCB- and lead-contaminated soils at the site. During the first three days of testing, EPA conducted detailed sampling of solid waste feed, stack gas, primary furnace off-gas, furnace ash, scrubber liquid effluent, scrubber water influent, scrubber effluent solids, and ambient air. During the remaining six days of operation, Shirco varied several operating parameters, and EPA sampled furnace ash, furnace off-gas, scrubber effluent, and stack emissions. In particular, the test investigated the effect of varied operating conditions on the fate of lead in the system. The stack discharge from the unit was monitored closely to determine the effectiveness of the technology and to ensure the health and safety of individuals in and around the project area. A final technical report on the demonstration is scheduled to be completed in June 1988.

American Combustion, Inc.

Technology

American Combustion, Inc. (ACI), has developed the PYRETRON, an oxygen- air-fuel burner, which can be fitted onto any conventional combustion unit for burning liquids or solids and sludges (See Figure 2).

Pure oxygen in combination with air and natural gas is combusted in a proprietary burner to destroy liquid hazardous waste. Solids and sludges can be coincinerated when the burners are used in conjunction with a rotary kiln or similar equipment. The use of oxygen allows a higher burning temperature (up to 4500°F as compared to a maximum of 2400°F in a conventional burner) without the addition of excess air. Using less air is advantageous because the nitrogen in air takes away heat, puts a greater load on the air pollution control equipment, and requires a longer retention time in the combustor before the waste is fully incinerated. The higher temperatures also ensure more complete incineration of the wastes, thereby increasing the destruction and removal efficiency and reducing stack gas emissions. The rate of waste through-put is also increased, thus reducing unit costs.

The PYRETRON burner is a proprietary design which employs advanced fuel injection and mixing concepts to provide faster ignition and more thorough burning of wastes. Burner operation is computer controlled to automatically adjust the amount of oxygen according to sudden changes in the heating value of the waste.

Progress and Accomplishments

Site Selection. Prior to the initial SITE solicitation, the American Combustion, Inc., PYRETRON burner was selected for research at EPA's bench-scale facility at Research Triangle Park. The proposal from American Combustion was subsequently accepted and a demonstration at the larger-scale EPA Combustion Research Facility (CRF) in Jefferson, Arkansas, was planned.

Contaminated soil from the Stringfellow Acid Pit Superfund site in California is being burned during the demonstration at the CRF. The Stringfellow site is a 17-acre remedial site in a California canyon that was used as a dump for industrial wastes from World War II to the early 1980s. The site contained about 20 unlined ponds into which were dumped waste acids

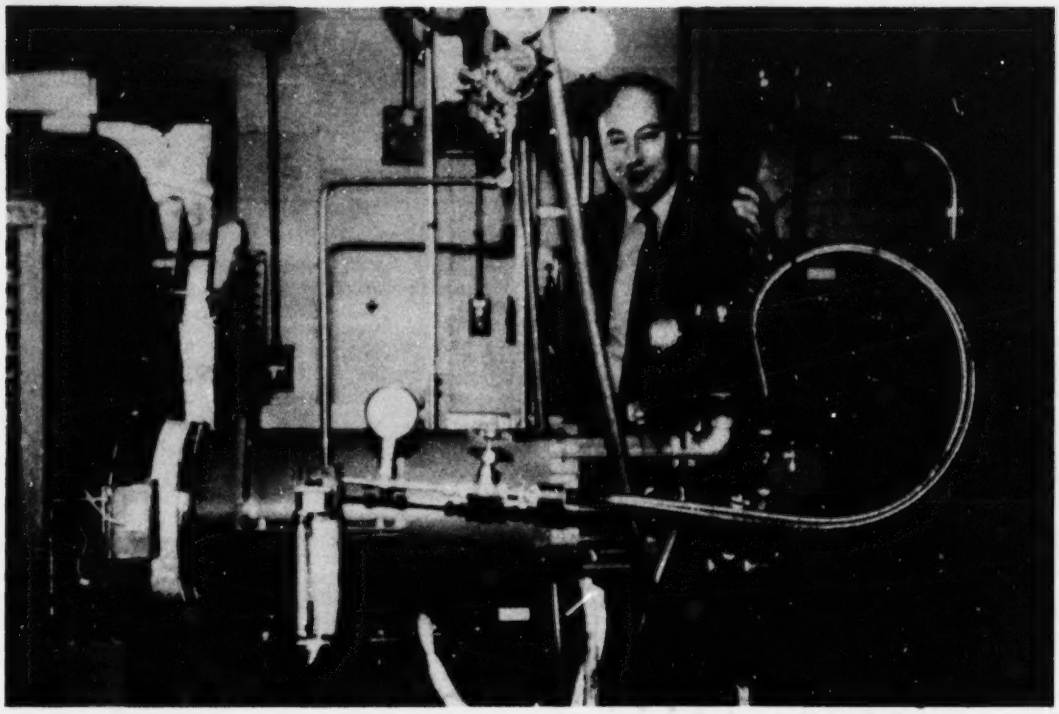

Figure 2. Pyretron ™ Oxygen Enhanced Burner

containing metals and organics. In addition to some five dozen organic compounds, a large amount of sulfuric acid was deposited at the site. The surface liquids have been removed, but contaminated soils and rock remain. Chemicals from the site have leached into the drinking water supplies of the nearby town, Glen Avon. Wells have been installed at the site for pumping water to an on-site treatment plant. California has the lead in cleaning up the site and is considering thermal treatment; thus the demonstration will have direct application to the feasibility study the State is preparing.

Community Relations. EPA and the State of California have developed and distributed information to the community to introduce the SITE Program. At a Stringfellow public meeting held in July 1987, EPA addressed the excavation of wastes for the demonstration and the role of the SITE project in the overall remediation process. A public visitors' day was held on November 20, 1987.

Demonstration Status. The demonstration of the PYRETRON burner began November 16, 1987, and is scheduled to be completed by the end of January 1988. The objective of the demonstration tests is to provide data to evaluate three ACI claims:

1) The PYRETRON System reduces the magnitude of the transient high levels of organic emissions, carbon monoxide, and soot ("puffs") that occur with repeated batch charging of waste to the rotary kiln.

2) The PYRETRON System is capable of acheiving the RCRA-mandated 99.99 percent destruction and removal efficiency (DRE) of principal organic hazardous constituents in wastes incinerated at a higher waste feedrate than for conventional air-only incineration.

Figure 3. Hazcon's Truck-Mounted Solidification/Stabilization System

3) The PYRETRON system is more economical than conventional incineration.

It is anticipated a final technical report on the demonstration will be completed in July/August 1988.

Hazcon, Inc.

Technology

The Hazcon solidification/stabilization process uses a patented nontoxic chemical blend which Hazcon claims encapsulates organic molecules and renders them ineffective in retarding or inhibiting solidification. The wastes are then mixed with pozzolans (such as fly ash, kiln dust, or portland cement) and water to immobilize and bind the contaminants into a hardened concrete-like mass. The encapsulated material attains compressive strengths between 1000 and 5000 psi. It is nearly impermeable, denser than concrete, and only slightly porous. The Hazcon process utilizes mobile field blending units. These units, mounted on trucks or trailers (See Figure 3), consist of soil and cement holding bins, a chloranan feed tank, and a blending auger to mix all of the components. Water is added as necessary, and the resultant slurry is transferred to molds.

Progress and Accomplishments

Site Selection. The Douglassville Disposal Superfund site located in Union Township, Berks County, near Douglassville, Pennsylvania, was chosen as the demonstration site for the Hazcon technology. The 50-acre site is an abandoned oil recovery facility on the floodplain of the Schuylkill River. The site includes two large lagoons once filled with waste oil sludges and subsequently drained and backfilled with soil, an oily filter cake disposal

area, an oil drum storage area, and an area where waste oil sludge was land-farmed into the soil. More than 250,000 cubic yards of soil may be contaminated with a wide variety of constituents including volatile organics, PCBs, and lead. A Record of Decision was signed in 1985 approving capping and diking of a portion of the site. However, additional engineering work is ongoing to consider the possibility of treatment.

EPA chose the Douglassville site for the Hazcon demonstration for the following reasons:

- It is relevant to the remedial analysis of the site.
- The developer requested a site containing oily wastes.
- It provides an opportunity to demonstrate fixation of both high concentration organic and metal-bearing wastes.

Community Relations. A public notice and comment period was held during August with a public meeting held on September 9, 1987. An environmental review was performed and the State of Pennsylvania was given an opportunity to comment on the project during its intergovernmental review. The public comment period ended with no significant comments raised. A public visitors' day was held on October 14, 1987.

Demonstration Status. The demonstration took place October 13-16, 1987. The primary objectives of the demonstration were to evaluate reduced contaminant mobility and the integrity of the solidified soil mass. Wastes from six areas of the site were chosen for the demonstration. Five cubic yards of each of the six feedstocks were processed, two to three feedstocks each day, with the last day being an extended run processing 25-30 cubic yards. Samples were taken from the untreated soil feedstocks and from the blended slurry for analysis after seven days of curing. The solidified blocks were buried and core samples were taken after 28 days of curing. The samples were analyzed for soil characteristics, leachability, permeability, unconfined compressive strength, microstructure changes, and contaminant levels. A final technical report is scheduled to be completed in May 1988.

Terra Vac, Inc.

Technology

Terra Vac, Inc., has developed a process for the in situ vacuum extraction of volatile organic compounds (VOCs) from soils and groundwater. The major functional parts of the system are a subsurface extraction well and a vacuum pump. The capacity of the vacuum pump and the depth of wells used at a site are dependent on the subsurface conditions (i.e., soil type, stratigraphy, groundwater depth) and the chemical characteristics of the contaminants (i.e., vapor pressure, solubility). The vacuum induces a negative pressure gradient in the well, which propagates laterally (10 feet to more than 100 feet depending on soil conditions), volatilizing liquid and adsorbed VOCs (See Figure 4). The gases migrate through the soil to the area of lowest pressure (the well), where they are extracted and pulled through separation tanks and an air emission control technology apparatus before being discharged to the atmosphere. Various air emission control technologies include activated carbon adsorption, thermal oxidizers, catalytic oxidizers, or simple dispersion stacks.

The process has been applied to a wide range of volatile compounds such as chlorinated organic solvents. The process is capable of removing volatile contaminants from the vadose zone, the layer of soil below the surface and above the water table. Terra Vac can use existing monitoring wells, if they are properly constructed, and Terra Vac's process can also be used for groundwater recovery and treatment, if necessary.

Progress and Accomplishments

Site Selection. The site chosen for this demonstration is the Groveland Wells Superfund site, Groveland, Massachusetts. This site contains two municipal wells along with the surface water and groundwater that supply them. Valley Manufactured Products Company, Inc., a machine shop at the site, is one of three

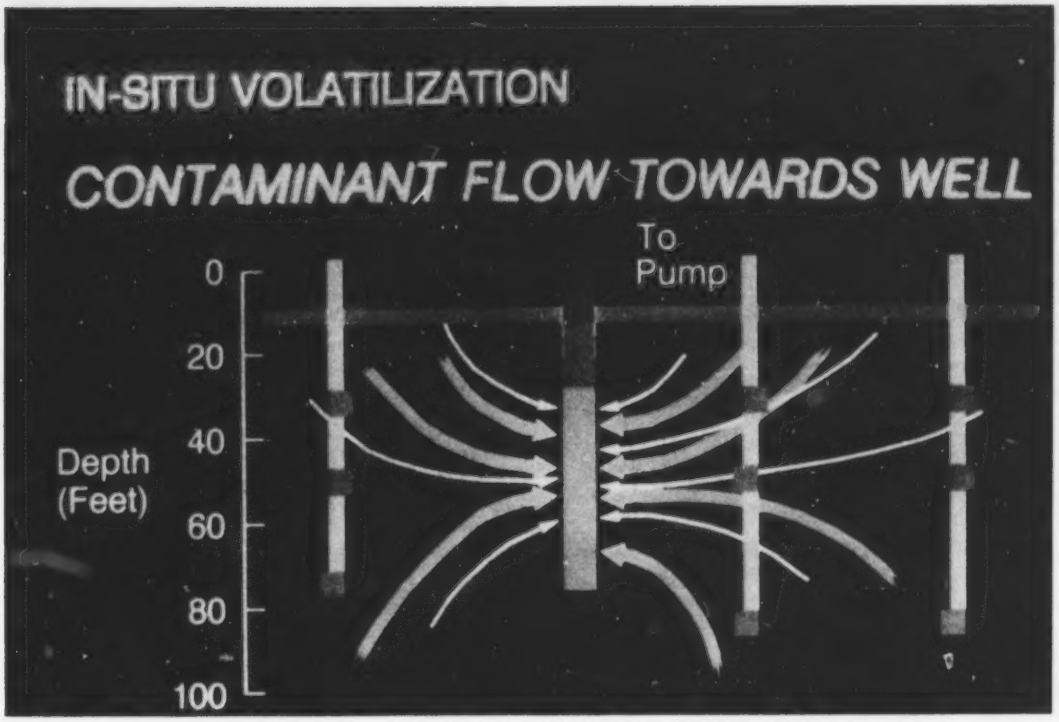

Figure 4. Terra Vac, Inc.'s In-Situ Vacuum Extraction Process

potential sources of soil and groundwater contamination resulting from surface and subsurface disposal of solvents and cutting oils. A two-acre area containing 2000 to 3000 cubic yards of soil is contaminated with volatile organic compounds, principally trichloroethylene, with lesser concentrations of 1,2-trans-dichloroethylene and tetrachloroethylene.

EPA chose the Groveland site for the Terra Vac, Inc., demonstration because of the desirable depth of the watertable and relevance to the ongoing feasibility study. For example, most of the contamination at the facility occurs above the water table and beneath a concrete slab which is being used as a storage platform. Thus, as part of the feasibility study, EPA is considering in situ treatments such as soil-flushing and vacuum extraction because excavation of soil beneath the facility would be difficult due to space constraints, the proximity of local residents to the site, and the potential for health and safety incidents. The demonstration is expected to provide data on the feasibility and cost effectiveness of in situ vacuum extraction as a possible alternative treatment of VOCs at the Groveland site.

Community Relations. On July 16, 1987, EPA Region I issued a public notice of the proposed demonstration and announced a public meeting for July 29. Fifteen citizens and local, State, and Federal officials attended; the reaction was generally supportive of the demonstration. An environmental review was performed and both the State of Massachusetts and Puerto Rico reviewed the project during the intergovernmental review. A public visitors' day was held January 15, 1988.

Demonstration Status. The demonstration plan has been completed. The demonstration site

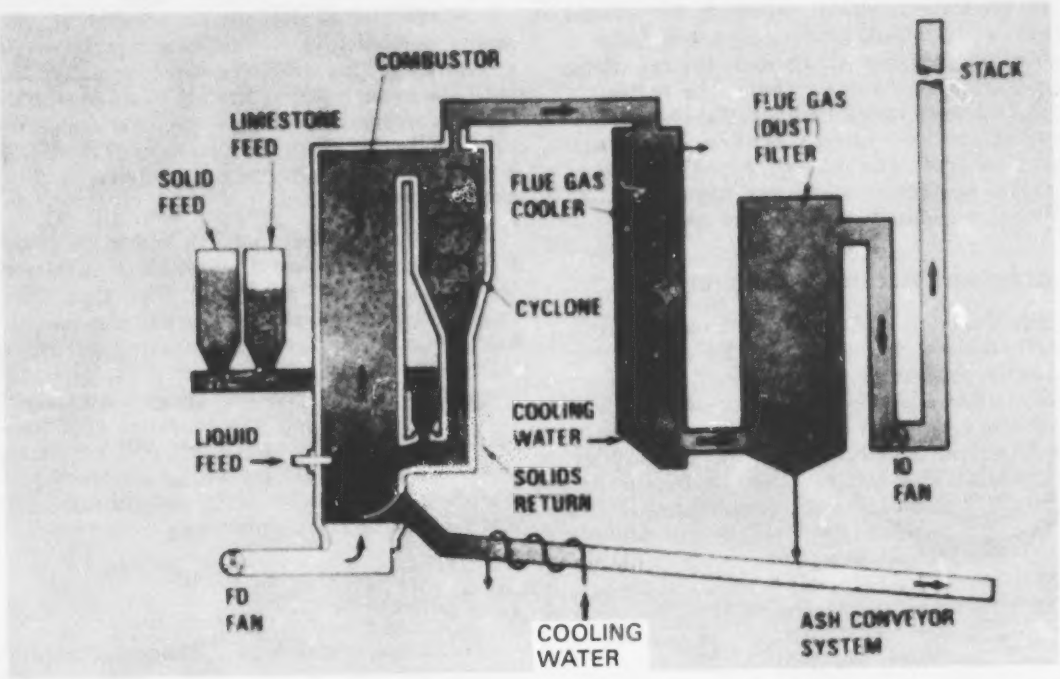

Figure 5. Circulating Bed Combustor Unit

preparation began November 30 and continued until December 18, 1987. Field work resumed January 4, 1988. The demonstration officially began January 8, 1988, and is expected to last through April. The demonstration is to provide data to evaluate *in situ* vacuum extraction of VOCs in the soil beneath a building at the site. The test will measure the ability of the technology to reduce the level of contaminant concentration in the soil. Four extraction wells have been drilled at the edge of the contamination zone; three of the wells are acting as barrier wells and intercept VOCs that would normally be drawn to the main extraction well. The vacuum extraction system is operating continuously (24 hours per day). Samples collected and analyzed daily include: soil gas; process gas (from various locations of the vacuum system unit); activated carbon; liquid from the vapor/liquid separator; and stack gas emissions.

Ogden Environmental Services, Inc.

Technology

Ogden Environmental Services, Inc., has developed a circulating bed combustor (CBC), an improvement over traditional fluidized bed combustion because it yields improved performance and simpler operation (See Figure 5). The improvements arise in part from an increased fluidization of the bed in the combustion chamber (greater turbulence) and the reinjection of solids removed from the combustion gas. Stated advantages over other types of thermal units include lower temperature of operation, reduced NOx and CO generation, simplicity of solid/liquid/auxiliary fuel feed, and better contaminant removal. In particular, the system has achieved very high destruction and removal efficiencies for halogenated organics and other acid-containing wastes.

In the Ogden system, waste material and limestone, a neutralizer, are fed into a combustion chamber along with recirculating bed material from a hot cyclone. The materials travel at a high speed through the combustion chamber to the cyclone, where solids are separated from the hot gases, which pass through a convective cooler and baghouse filter before being exhausted to the atmosphere.

Progress and Accomplishments

Site Selection. Wastes from two California Superfund sites, Stringfellow and McColl, were originally scheduled to be taken to Ogden's facility in San Diego for the demonstration. The Stringfellow site has already been described. (See American Combustion, Inc., Technology description.) The McColl site, in Fullerton, California, covers 9.5 acres, bordering both the Los Coyotes National Park and a golf course. Pits at the McColl site were used to dump asphalt, tars, and drilling muds from oil production and refining from 1942 to 1962. The resulting wastes are a mixture of very oily, odorous substances and soils containing high levels of organics and sulfur. The original Record of Decision signed in 1983 recommended off-site disposal but the State and EPA are reevaluating the remedy options.

The State was already considering using the Ogden combustor to run treatability tests on these wastes as part of their feasibility study, so EPA offered to evaluate these tests under the SITE Program. Both of these wastes have a high sulfur content. This acidic characteristic will test the circulating bed combustor's ability to neutralize waste, thus minimizing corrosion and extending the unit's operating life. Wastes from both sites have been excavated and are awaiting shipment to the Ogden facility pending the issuance of a local use permit from San Diego.

Community Relations. Public comment periods and hearings were held prior to issuance of Federal, State and local permits. EPA and the State of California developed and distributed information to the communities surrounding the two Superfund sites to introduce the SITE Program and address the role of the SITE project in the overall remediation process.

At the McColl site, the EPA Regional office meets periodically with a community action group. At a May 1987 meeting, the Regional staff discussed burning McColl waste during the Ogden demonstration. Once the local use permit is issued to Ogden, the Region intends to develop a fact sheet on the demonstration for the community.

Demonstration Status. On March 30, 1987, EPA Region IX issued an RD&D permit to Ogden to operate the CBC. The California Department of Health Services has also issued a hazardous waste facility operating permit to Ogden Environmental Services, Inc. On December 8, 1987, the San Diego City Council voted 7 to 2 to deny the issuance of a local conditional use permit to Ogden. As a result, the Ogden transportable CBC will be used for an on-site demonstration at a Superfund site. Site selection is presently underway.

Resources Conservation Company

Technology

BEST (Basic Extraction Sludge Technology) is a patented solvent extraction-type process for dewatering and deoiling hazardous sludges and contaminated soils (See Figure 6). BEST employs the unusual inverse miscibility properties of aliphatic amines (soluble in water below room temperature and insoluble above) to break difficult-to-handle emulsions and suspensions. Sludges that resist physical/mechanical concentration are easily separated by BEST into three distinct fractions: dischargeable water, reusable oil/organics, and dry, oil-free solids. Heavy metals are isolated by conversion to hydrated oxides, which precipitate out and exit the process with the solids fraction.

Progress and Accomplishments

Site Selection. During early 1987, the BEST system was in use as part of a removal action at the General Refining Superfund site near Savannah, Georgia. EPA recognized this as an opportunity to evaluate the performance and reliability of the technology under the SITE Program. Unfortunately, the removal operation was completed in early March 1987, before funds were available for the SITE evaluation contractor. The developer is currently

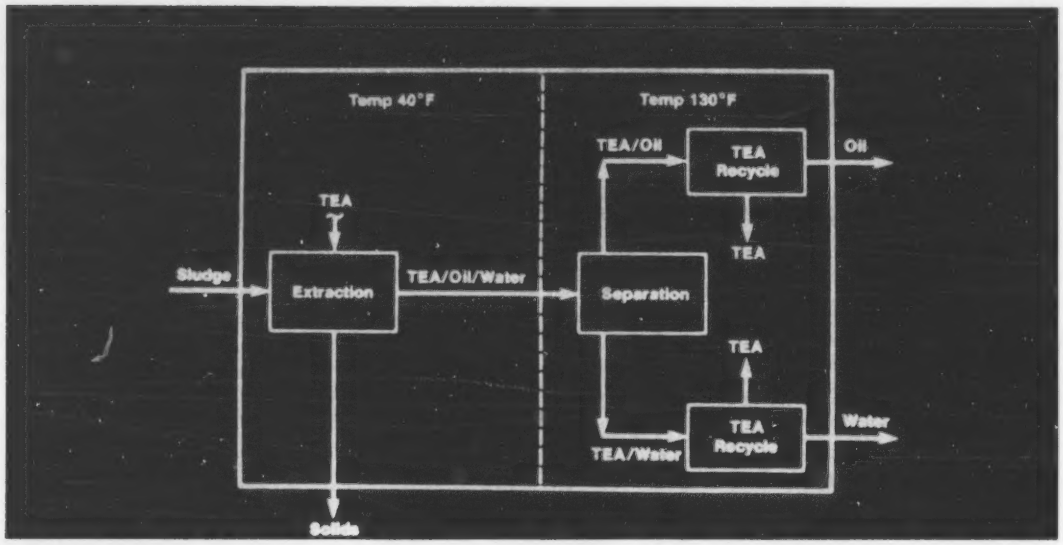

Figure 6. Basic Extraction Sludge Technology Field Equipment Program

negotiating the use of BEST for a remediation action at another Superfund site which could provide an opportunity for a technology demonstration.

Community Relations. The BEST demonstration has not reached the level of planning to warrant community relations activities as no site has been selected.

Demonstration Status. On November 19, 1987, more data from the remediation action at the General Refining Site near Savannah, Georgia, were received. Based on the evaluation of these data, Resources Conservation Company was officially accepted into the SITE Program on December 2, 1987.

International Waste Technologies

Technology

International Waste Technology's (IWT) in situ stabilization/solidification process utilizes proprietary chemicals and a unique soil mixing technology which precludes the need for soil excavation. IWT claims that the process generates a complex crystalline connective network of organic polymers in a two-step reaction. The first reaction is reported to produce chemical bonding between the IWT chemicals and the ions and neutral organics present in the soil. The second reaction involves building macromolecules which are generated over a long period of time.

The method for injecting the chemical into the soil involves a widely used Japanese technology which utilizes a hollow drill with helical blades containing injection ports (See Figure 7). The drill is advanced into the ground to the desired depth. The chemical additive is then injected at low pressure to prevent excessive spreading and is blended with the soil as the drill rotates. The treated soil forms a solid vertical column. Soil columns overlap to ensure all the soil is adequately treated. The soil surface is then covered with a layer of asphalt to protect the solidified mass from rain and water erosion.

Progress and Accomplishments

Site Selection. IWT's *in-situ* stabilization/solidification process demonstration is tentatively scheduled to occur during a test of the process at the General Electric (GE) site in

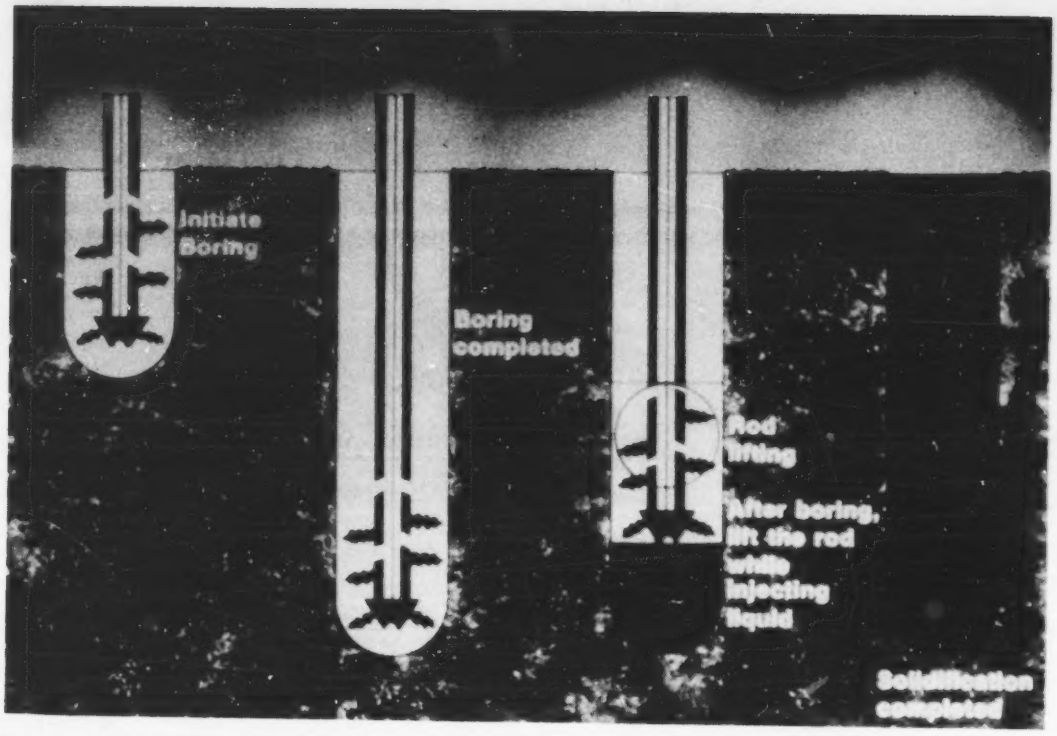

Figure 7. International Waste Technologies' In-Situ Stabilization/Solidification Process

Hialeah, Florida. About 7000 cubic yards of soil are contaminated with PCBs which were disposed of on-site. Because this is not a Superfund site, but a private developer site, the demonstration is currently awaiting a decision by GE to proceed with the cleanup.

Community Relations. There have been no EPA-sponsored community relations activities for this SITE demonstration as this is a private clean-up at a non-Superfund site.

Demonstration Status. Both EPA and IWT are fully prepared to conduct the demonstration. A delay has been encountered because General Electric has not committed to a project start date. The general objectives of the demonstation will be to evaluate the ability of the method to immobilize PCBs and the uniformity and integrity of the in situ solidified soil mass.

Detox Industries, Inc.

Technology

Detox Industries, Inc., has developed a biological process for the degradation of targeted organic contaminants in a water/sludge/soil matrix through the application of proprietary naturally occurring nonpathogenic organisms. The process involves the accelerated growth of these microorganisms and eventual inoculation into the soil or other matrix in which the waste is contained. Nutrients and catalysts are added to the matrix to enhance the microbial activity. Subsequent inoculations of microorganisms, nutrients, and catalysts are added over time on an as-needed basis. The result is a systematic biodegradation of the contaminants over a

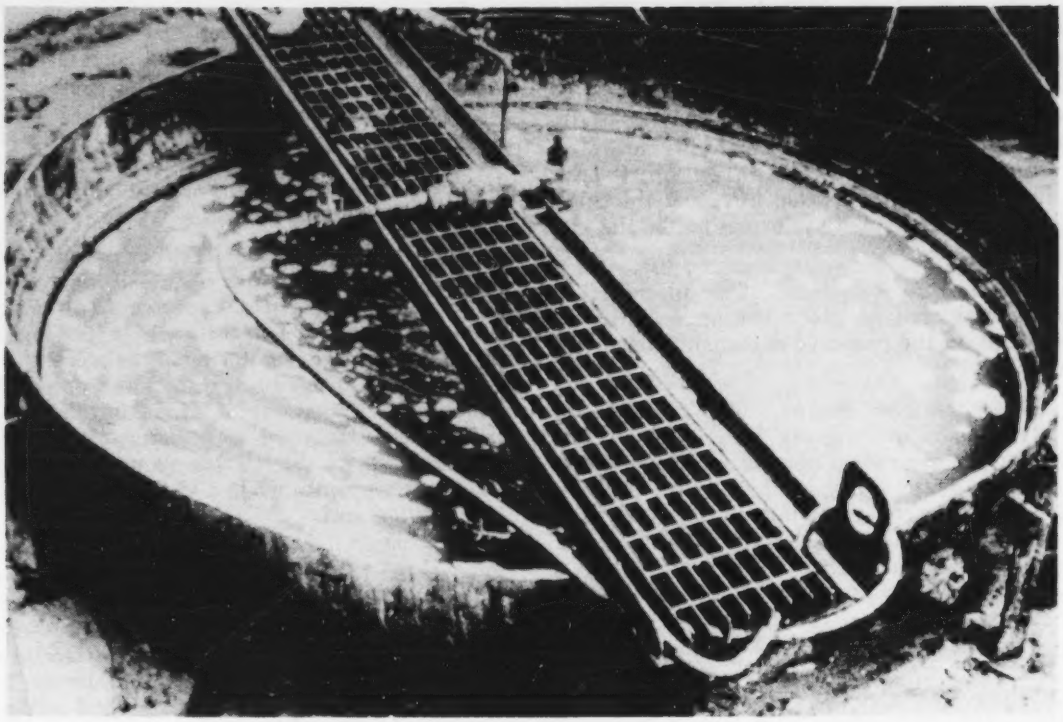

Figure 8. Detox Industries Process Treatment Tank with Waste Being Treated

relatively short period of time (usually two to four months). Detox claims that the process can be applied on-site in soil or sludge as well as in open tanks where depth of contamination makes in situ treatment impractical (See Figure 8).

Byproducts of metabolic consumption are carbon dioxide, water, and cell protoplasm. Once the contaminants have been biodegraded, the microorganisms die due to the lack of adapted food source, leaving nonhazardous cell protoplasm behind, which in turn acts as a food source for the indigenous microorganisms present in the matrix.

Progress and Accomplishments

Site Selection. EPA selected the United Creosote Superfund site, a wood preservation facility in Conroe, Texas, for the technology demonstration. The company used a pressurized treating process employing pentachlorophenol (PCP) and creosote. Creosote was produced on the site from the distillation of coal tar and is a sticky substance consisting mainly of polycyclic aromatic hydrocarbons (PAHs). The PCP was not produced on-site but was stored in above-ground tanks. The total site comprises 100 acres and contains two large waste ponds which were used to treat or dispose of the creosote wastes. Leaching from ponds is causing a plume of contaminated groundwater. The pond area has a temporary soil cover installed by EPA to divert runoff. There are approximately 85,000 cubic yards of soil contaminated with PCPs, PAHs, dibenzofurans, and chlorinated dioxins. The wood preserving facility was demolished in 1975 and the property was sold, half for business development and half for residential development.

EPA Region VI is coordinating with the Texas Water Commission on a nine-month study to explore treatment technologies that may permanently clean up the site. Biodegradation

and contaminant desorption (soil washing) are two possible alternatives.

The contamination at the sites consists entirely of organic chemicals which potentially can be destroyed by the biodegradation technique. It is anticipated that this demonstration will provide EPA and the State with useful and timely information for the site cleanup.

Community Relations. The surrounding community will be given the opportunity to comment on the proposed demonstration in the near future.

Demonstration Status. The treatability study plan is undergoing final review. The revised demonstration plan is scheduled to be completed by the end of January 1988. An access agreement for the treatability study has been obtained, and this study is tentatively scheduled to begin in February 1988. The demonstration is planned for May through September 1988.

Westinghouse Electric Corporation

Technology

Westinghouse has developed two thermal technologies to be demonstrated in the SITE Program -- the Pyroplasma System and the Electric Pyrolyzer.

The Pyroplasma System is based on the concept of pyrolyzing waste molecules using a thermal plasma field. The unit has been developed to destroy liquid organic waste by dissociation to its component elements. The heart of the destruction system is a plasma torch (See Figure 9). The system uses 800 kW of electric power across a colinear electrode assembly to produce an electric arc in a medium of dry low pressure air. The intense energy causes the air stream to become ionized, producing a thermal plasma with temperatures ranging from 5,000 to 15,000°C.

Liquid waste is injected directly into the plasma where the hazardous molecules are broken down to their atomic states in an oxygen-deficient atmosphere. The atoms then recombine according to chemical kinetics to produce hydrogen, carbon monoxide, nitrogen, hydrogen chloride, particulate carbon and small amounts of carbon dioxide, ethylene, and acetylene. The product gas is scrubbed with caustic soda to neutralize and remove acid gas (HCl) and to remove particulate carbon. The scrubber fluid is used once. The remaining gas is drawn off by an induction fan and flared. The unit can process 2 to 3 gallons per minute.

The entire system is process computer controlled. The computer updates temperature, pressure, flow, fluid reserve, and other performance parameters while providing continuous online monitoring of the process. The computer is programmed to shut down the process in the event of deviation from set parameters. Onboard monitoring of bulk gas constituents in the off-gas is provided. The entire unit is contained in a 48-foot trailer.

The Electric Pyrolyzer is a mobile system designed to thermally destruct hazardous organic wastes, without combustion (See Figure 10). The system operates a rapid transfer of energy to waste materials causing dissociation of organic molecules into individual atoms. The destruction of wastes is accomplished without oxidation and the associated generation of products of incomplete combustion (PIC).

The Electric Pyrolyzer will accept a wide range of waste types including both liquid and solid waste. The prototype system is designed to process 5 to 20 tons per day of solid waste containing up to 10% (by weight) organics and up to 25% (by weight) water. Input materials may range in size from fine powders and sludges to large solids (< 4 inches in diameter).

The Electric Pyrolyzer is designed to operate at temperatures up to 3250°F. Residence times for materials in the gaseous and liquid phases are fully controllable by the operator. Thus, a wide range of destruction efficiencies may be achieved, depending on regulatory requirements. The resultant products are vitrified solids and clean off-gas.

Progress and Accomplishments

Site Selection. No Superfund site has yet been selected for either demonstration.

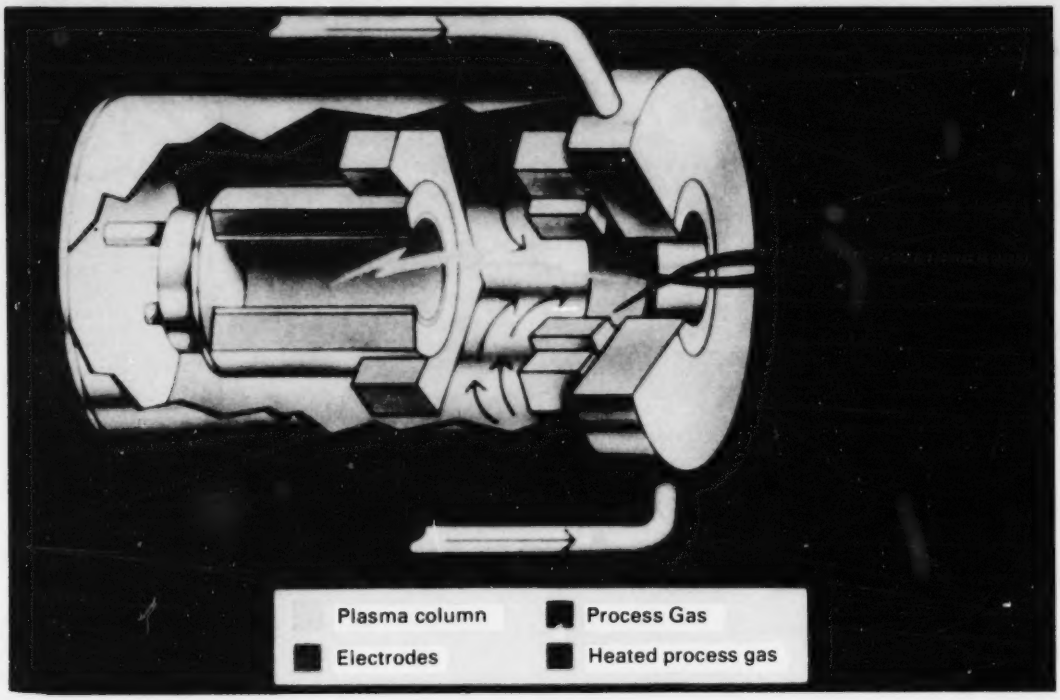

Figure 9. Schematic of Westinghouse Plasma Torch

Demonstration Status. Currently, Westinghouse has both units at their Waltz Mill, Pennsylvania facility for further modifications and testing. Westinghouse is also awaiting issuance of an RD&D permit by EPA. EPA plans to observe and/or collect data from the Westinghouse testing. Upon successful operation of the units, EPA will select Superfund sites for the SITE demonstrations of each unit, which could occur in mid-1988 if Westinghouse's testing indicates the units are operational and ready for field demonstration.

New York State Department of Environmental Conservation (NYSDEC)

Technology

The New York State Department of Environmental Conservation (NYSDEC) and EPA established a cooperative agreement in 1982 for the construction and testing of a mobile plasma arc system for the destruction of liquid hazardous wastes. The project consisted of four phases:

- Phase I: Design and construction of the unit by NYSDEC's contractor, Pyrolysis Systems, Inc.
- Phase II: Performance testing of the unit at the Kingston, Ontario, Canada test site.
- Phase III: Installation of the plasma arc system and additional performance testing at a site in New York.
- Phase IV: Demonstration testing as designated by NYSDEC at a New York hazardous waste site.

The first two phases were completed in Canada by April 1986. Refer to the Westinghouse Pyroplasma System (described

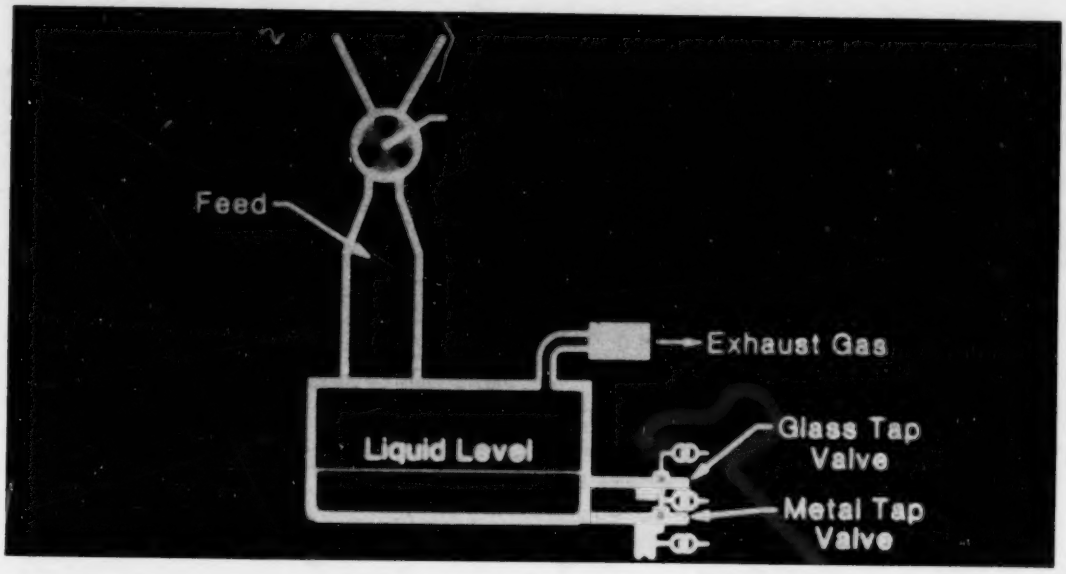

Figure 10. Side View of the Westinghouse Electric Pyrolyzer

previously) for a description of the plasma arc system.

Progress and Accomplishments

Site Selection. In accordance with Phase III of the EPA/NYSDEC agreement, New York State chose the Love Canal site for testing the unit. Perimeter drains installed around Love Canal have been intercepting underground water (leachate) for treatment. Oily sludges are separated from the leachate and stored on-site. It is these sludges, containing 200 to 300 different chemicals, including dioxins and many chlorinated organics, that will be destroyed in the plasma arc unit.

Community Relations. Since 1982, NYSDEC has held regular public meetings involving Love Canal and has discussed the plasma arc at several; one meeting was dedicated solely to the use of the plasma arc on Love Canal waste. In May 1986, NYSDEC held a weekend open house where the community could walk through the mobile plasma arc unit and talk with State and contractor staff; approximately 300 to 400 people attended. The NYSDEC has an office located at Love Canal, with two full-time employees dedicated to community relations. One of the office functions is to publish regular notices and a quarterly newsletter on site activities, including the status of the plasma arc demonstration. New York has chosen to follow the State Environmental Quality Review Act which requires a public hearing on this demonstration project.

Demonstration Status. In October 1986, EPA accepted the plasma arc demonstration into the SITE Program. New York has the lead in cleaning up the site and has decided to meet all substantive technical permit requirements, including complying with RCRA, the New York State air regulations, the New York State Pollution Discharge Elimination System regulation, and drafting an environmental impact statement. EPA is assisting NYSDEC in developing these documents. Based on receiving the approvals, the demonstration is planned for the Spring of 1988.

Site 002 Demonstration Project Descriptions

SITE 002 Projects were accepted into the SITE Program in September 1987, and site selection is underway. EPA's Regional Offices

have recommended sixteen sites to be considered as demonstration locations.

Retech, Inc.

Retech, Inc., offers a technology that uses a centrifugal reactor with plasma heat to decompose organics in a mixed solid and liquid feedstock. The solid components are melted and cast or granulated for disposal. The volatile compounds are vaporized and decomposed in an afterburner heated by plasma heat in an oxygen-enriched atmosphere. The off-gases from the afterburner are treated for removal of fine particles and scrubbed.

During the process, solid and liquid wastes are fed steadily through a hollow trunnion into the spinning reactor well. A plasma torch, with the arc transferred to a conducting spindle, adds energy to the feedstock. The spinning motion spreads out the charge; the plasma heat turns liquids into gas, and solids into glassy or metallic liquids. The temperature of the condensing phase is so high that no combined carbon can remain. If the melt is metal, it may dissolve some carbon. The condensed phase accumulates in the centrifugal reactor bowl. When removal of the condensed phase is desirable, the reactor is tilted by a hydraulic mechanism and the "slag" is poured into a cooling mold. The scrubber water contains enough caustics to tie up halogens in the off-gas. Almost all the scrubber water is recycled, adding enough makeup to keep dissolved solids below the saturation level.

C.F. Systems

C.F. Systems offers a solvent extraction technology that uses liquefied gases near their critical conditions as solvents to remove organic constituents from sludge, solid, or liquid wastes. The proposed solvents have lower viscosities and higher diffusivities, allowing more favorable rates of mass transfer than other solvent extraction processes. The patented processes include a combination of liquefied gas extraction with vapor recompression and conventional distillation to recycle the solvents and concentrate the organic constituents in an effluent stream. The effluent stream may require further treatment prior to land disposal.

Soliditech, Inc..

The Soliditech solidification process uses the concept of microblending and micro-encapsulating hazardous waste materials. Microblending is used to thoroughly mix the reagent, URRICHEM, with the waste stream. Microencapsulation occurs by cross-linking the organic and inorganic particles during a five-phase cementation process, coating the large particles with pozzolanic materials, and by sealing the matrix containing micropores and spaces. The reagent formula can be modified for the treatment of a specific waste thus optimizing the chemical reaction and resulting character of the solidified waste.

Chemfix Technologies

The Chemfix fixation/stabilization process is based on the use of soluble silicates and silicate setting agents. The combination and proportions of reagents are optimized for each particular waste requiring treatment. Three classes of interactions can be described:

- A reaction between soluble silicates and polyvalent metal ions, producing insoluble metal silicates.
- A reaction between soluble silicates and reactive components producing a gel structure.
- Hydrolysis, hydration, and neutralization reactions.

The Chemfix process may be useful for the reduction in toxicity of high molecular organics (BNA and PAHs) and the immobilization of metals.

Waste Chem Corporation

Waste Chem Corporation has developed a mobile volume reduction and solidification system, designed to decontaminate and solidify liquids, sludges, or dried soils. The system consists of a two-stage process:

1) A fluidized waste stream feed and an asphalt stream are simultaneously fed to an

extruder-evaporator unit. The waste-asphalt mixture is discharged into a 55-gallon drum where solidification is allowed to take place. The extruder is heated indirectly causing constituents to volatilize.

2) Organic volatiles are then scrubbed with a caustic solution and condensed volatiles are stored in a tank where further treatment is provided by ozonation. Residues from the ozonation tank as well as uncondensed volatiles are filtered through carbon absorption filters. These filters may need to be incinerated prior to land disposal.

Batelle Pacific Northwest Laboratory

The Battelle Pacific Northwest Laboratory has developed an in situ vitrification technology, a thermal treatment process which converts contaminated soil or sludge into a chemically inert, stable glass and crystalline product. Because the soil is not electrically conductive once the moisture is driven off, a conductive mixture of flaked graphite and glass frit is placed among the electrodes to act as a starter path. An electrical potential is applied to the electrodes establishing an electrical current. The graphite starter path is eventually consumed by oxidation and the current is transferred to the soil which is electrically conductive in the molten state. As the vitrified zone grows, it incorporates nonvolatile elements and destroys organic components by pyrolysis. The pyrolized products migrate to the surface of the vitrified zone where they may oxidize in the presence of oxygen. A hood is placed over the processing area to confine any combustion products. All gases are then drawn into an off-gas treatment system. This process was developed primarily for vitrifying nuclear waste at the Hanford-Department of Energy facility in Richland, Washington.

Sanitech, Inc.

Sanitech, Inc., has developed a technology that uses ion-exchange-like materials to process and selectively remove toxic heavy metals from contaminated groundwater or surface waters. The new materials are stronger and more abrasion resistant than resins. They operate over a wide pH range, have high absorption capacities, and appear unaffected by most organic contaminants and changes in temperature or pressure.

A series of compounds, selective to one or several similar metals, have been developed by the substitution of electrophilic groups onto the benzene ring of catechol-type siderophore. Metal-contaminated water can be passed through a bed of the coated particles, during which time the metal is selectively removed from the water. A method has been developed to chemically attach the compounds to silica spheres. In all past experiments, the selected captured metal ions have been completely recovered from the bed material by acid treatment. The bed material has been fully regenerated for reuse.

Air Products and Chemicals, Inc., (Formerly Dorr-Oliver)

This technology offers a mobile biotreatment technique for treating aqueous waste containing hazardous and toxic organic substances. A fixed-film fluidized-bed biological reactor contains either an inert media or activated carbon as the fluidized media. Pure oxygen is predissolved and totally consumed in the process thus limiting air stripping of volatile organics. The use of activated carbon as the media in the Oxitron Activated Carbon System improves the treatment capabilities of the basic Oxitron system. Components which are easily biodegradable are rapidly converted to carbon dioxide and water. Organic compounds are adsorbed on the carbon, producing an effluent consistent with conventional activated carbon treatment. Compounds which degrade more slowly, however, are eventually converted biologically.

Zimpro Environmental Control Systems

Zimpro Environmental Control Systems offers a powdered activated carbon treatment (PACT) process using a biological treatment process. In the PACT process, powdered activated carbon is added to the aeration basin at a dosage that varies depending on the biodegradability and adsorptive characteristics of the waste material. Treatment effectiveness

depends on the carbon dosage applied and other process parameters such as the hydraulic retention time of the wastewater in the aeration basin, the solids residence time of the carbon and biomass, and the carbon concentration in the aeration basin.

Motec, Inc.

MoTec, Inc., offers a three-stage aerobic organic waste biodegradation process. In the first stage, water and emulsifiers are mixed with contaminated sludges or soils. In the second stage, after the organics have been solubilized, the mixture is transferred to a batch digester, where acclimated seed bacteria are added and aerobic biological oxidation occurs. The third stage is a biological step where target concentration levels of organics are achieved. The technology is known as liquid/solids contact digestion. The system uses portable tanks or lined in situ earthen digesters.

MEASUREMENT AND MONITORING TECHNIQUES DEVELOPMENT

One of the components of the SITE Program is the demonstration and development of new and innovative measurement and monitoring technologies which will be applicable to Superfund site characterization. There are four important roles for monitoring and measurement technologies at Superfund sites: (1) to assess the extent of contamination at a site (remedial investigation and for the Hazard Ranking System), (2) to supply data and information to determine impacts on human health and the environment (exposure and risk assessment), (3) to supply data to select the appropriate remedial action (feasibility study), and (4) to monitor the success or effectiveness of the selected remedy.

EPA has been involved with the development and evaluation of monitoring methodologies practically since its inception. EPA monitoring research has focused primarily on the application of existing technologies to support its monitoring requirements. EPA has been conducting research and development projects concerning geophysical instrumentation, monitoring well design, sampling strategies, site characterization, groundwater flow and contaminant transport modelling, soil sampling, and vadose zone monitoring, among other areas.

With the enactment of SARA, EPA has been supplied with a mechanism specifically aimed at supporting monitoring needs at Superfund sites. The Environmental Monitoring Systems Laboratory in Las Vegas, Nevada (EMSL-LV) has been supporting the development of improved measurement and monitoring techniques in conjunction with the SITE Program, with a focus on two areas: immunoassays for toxic substances and fiber optic sensing for in situ analysis at Superfund sites.

Immunoassay Program

EMSL-LV's research on immunoassays for toxic substances actually began prior to the enactment of SARA. Laboratory researchers were initially interested in the use of biomarkers in exposure and risk assessment. In FY 1987, two requests for information (RFI) were published in the Commerce Business Daily soliciting input from industry concerning the State of the technology of biomarkers and immunoassays. As a result of the responses to the RFIs, two meetings were held in FY 1987 during which industry was invited to present the status of their research.

The application of immunoassays to environmental monitoring is still in the developmental stage and has received support from the SITE Program. During the first year of the SITE Program, EMSL-LV has initiated efforts in the following areas:

- Participation in the development and evaluation of a monoclonal antibody-based immunoassay for pentachlorophenol. Results of the initial testing of the monoclonal antibody assay, although promising, were not up to expectations because of prevailing irreproducibility of antigen binding to commercial plates. Subsequent research indicates that this problem can be overcome and will allow

relative standard deviations of less than 10% for repetitive analysis.

- Submission of two requests for information to the *Commerce Business Daily*. One requested information concerning general advancements in immunoassay technology and biomarkers. A number of innovative approaches were brought forward from the commercial sector. EMSL-LV has attempted to function as a catalyst to encourage the interaction necessary to advance the field, particularly for field screening applications. The second Request for Information was directed toward advanced analytical methods specifically for benzene, ethylbenzene, toluene, and phenol. As a result of that solicitation, a cooperative agreement is being negotiated with Westinghouse to develop monoclonal antibody assays for these chemicals.

- Initiation of an interagency agreement with the U.S. Department of Agriculture to develop monoclonal antibodies and immunoassays of mutual interest for monitoring programs.

- Negotiation of an interagency agreement with the California Department of Food and Agriculture for EMSL-LV to develop sample preparation techniques for environmental matrices which will be compatible with immunoassays. If consummated, activities will begin by mid-FY 1988.

- Negotiation of cooperative agreements with scientists at the University of California, Berkeley and Davis campuses, to develop monoclonal antibodies and immunoassays for selected compounds of interest to Superfund for which the commercial sector has shown little interest.

Fiber Optics Program

EMSL-LV embarked on a program in 1982 to determine the feasibility of using fiber optic sensing to monitor groundwater. The program was a fragment of the Lawrence Livermore National Laboratory sensor development program, and it led to the development of lightweight portable instrumentation, a sensor for organic chloride detection, a sensor for pH and, most importantly, an abundant interest in and new ideas for other fiber optic based chemical sensors. EPA is joined in fiber optic sensor research by the National Oceanic and Atmospheric Administration, National Institutes of Health, U.S. Geological Survey, Department of Defense, Department of Energy, National Bureau of Standards, National Aeronautics and Space Administration, and the industrial community.

In FY 1987, EMSL-LV applied SITE resources to its fiber optic sensor program. The fiber optic chemical sensor for chloroform (the primary tri- halomethane component) that has been under development for about three years has been significantly improved over the last six months. The latest modifications and calibration studies have permitted measurement of chloroform concentrations in soil gases above contaminated groundwater with confidence that the sensor response was linear between 2 and 12 ng/ml. The reproducibility at 6 ng/ml in the field was + 10%, which exceeded that of the portable gas chromatograph being used for verification in the field. In addition, the sensor results were obtained in only 10 to 20% of the time required for the chromatographic results. The latest modifications have resulted in a more sensitive and rugged sensor which can be reliably loaded with sensing reagent in about 10 seconds. However, the sensor is presently limited to making measurements in the gas phase.

TECHNOLOGY TRANSFER/ CLEARINGHOUSE

The technology transfer program initiated in November 1987 to support the SITE program is composed of three major components:

- a hotline, incorporated into the RCRA/CERCLA hotline

- an electronic bulletin board, using the office of Solid Waste and Emergency Response (OSWER) Technology Transfer Bulletin Board

- a collection of reports, journals, and other documents.

The hotline provides callers with up-to-date information on SITE projects, demonstration schedules, and the availability of data on demonstration results. It also serves as a referral source for callers, providing them with information on other resources available in the area of innovative hazardous waste treatment technologies. These resources include other databases on relevant topics, such as the Hazardous Waste Control Technology Database and individuals with particular areas of expertise.

The information available through the hotline has also been placed on the office of Solid Waste and Emergency Response (OSWER) Technology Transfer Bulletin Board. Users can access the bulletin board through a personal computer and obtain information on the SITE Program and other databases.

Finally, the EPA Library maintains a Hazardous Waste Collection which makes key documents available through the EPA library network. This Collection contains reports, books, EPA policy and guidance directives, legislation and regulations, periodicals, and a listing of commercial databases containing hazardous waste information. The database is accessible using a personal computer, and provides automated search and retrieval capability by the following access points: keyword or subject heading, abstract, title, author, sponsoring organization or office, project manager's name, or contract number. Documents related to innovative treatment technologies have been added to the collection and reports on SITE demonstrations will be added as they become available.

A one-page flyer describing the clearinghouse has been distributed to potential users at appropriate meetings and conferences. The flyer outlines the three components of the clearinghouse and methods of gaining access to each.

The Clearinghouse on Alternative Hazardous Waste Treatment Technologies was designed and initiated by an Implementation Committee composed of representatives from relevant EPA Headquarters, Regional offices, and Laboratories. This committee will continue to oversee the implementation of the Clearinghouse and plan for its future activities.

IV. PLANNED ACTIVITIES

The goal of the SITE Program in Fiscal Year 1988 and beyond is to expand its scope by furthering the development of technologies that are at the proof of concept stage and require additional developmental assistance to reach the field demonstration stage. In addition, the program will continue to support the evaluation of technologies provided by private industry at the pilot- and full- scale. Technologies developed by EPA also will be accelerated to the field demonstration stage.

DEMONSTRATION PROGRAM

The first year of the SITE Program concentrated its efforts and resources on the Demonstration Program. Since SARA Section209(b) requires initiation of at least ten field demonstrations per year, this component of the program will continue to be the primary focus in the coming years. At this time, 20 developers have been accepted into the SITE Program in the first two solicitation cycles, and it is anticipated that between 10 and 15 new ones will be added in 1988.

In 1988, site selection and other steps will be undertaken for SITE 002 projects, and demonstrations of remaining SITE 001 projects will occur. Reports on the performance, cost and applicability of these technologies will also be published as the demonstrations are completed. The solicitation for SITE 003 projects was announced in January 1988. Under this solicitation, EPA will permit co-funding of demonstration projects for the first time. This provision allows up to 50% cost-sharing by EPA of the total estimated cost of the demonstration not to exceed a total of $10 million per year or $3 million for any given project. To qualify, the developer must demonstrate that it cannot obtain private financing on reasonable terms and conditions that is sufficient to carry out the demonstration.

EMERGING TECHNOLOGIES PROGRAM

In FY 1988, the first Emerging Technologies Program solicitation was issued. It is expected that this solicitation, like the Demonstration Program, will be issued annually in the future. For 1988, projects will be selected that offer solutions to critical disposal and treatment problems at Superfund sites, have high potential for the successful transition from conceptual to demonstration stage, and show a major commitment or capability by the developer to commercialize the technology.

This Emerging Technologies Program will foster the further development of technologies or approaches that are not yet ready for demonstration. The goal is to ensure that a steady stream of more cost-effective technologies will be ready to be demonstrated, thereby increasing the number of viable alternatives available for use in Superfund cleanups.

The Emerging Technologies Program will deal with innovative technologies for recycling, separation, detoxification, destruction, and solidification/stabilization of hazardous constituents and material handling technologies. Candidate technologies must show promise at the bench/laboratory scale. This program will enable technology developers to advance from the bench/laboratory to pilot scale through cooperative funding with EPA.

New candidate technologies will be added as they become available if they appear to be extremely promising and rank high on a comparative evaluation using established ranking criteria. Flexibility must be built into a program such as this that deals with emerging technologies.

The first solicitation for the program appeared in the *Commerce Business Daily* on September 17, 1987. The program was also advertised in trade or professional journals, newsletters, and at conferences. The Request for Proposals was available on November 15. Pre-proposals were due on December 15, 1987. A total of 84 were received. Those developers selected to prepare full proposals will have until May 16, 1988 for submission.

The funding mechanism to be used for the Emerging Technologies Program is the competitive cooperative agreement. The maximum length of the cooperative agreements within this program will be two years. Maximum funding per project will be $300,000 total and $150,000 per year. EPA will fund part or all of an emerging technology project development. The developer must show progress after the first year before EPA will consider funding for a second year.

Proposal evaluation criteria will incorporate both technical and cost-sharing considerations, such as technical description of the technology, description of the proposed project, summary of data results to date, estimated resources (funding) needed for test project, company and personnel experience, and value of technology to Superfund program.

Thus, when proposals are technically equal, the degree of developer cost sharing will affect selection.

It is anticipated that there will be 5-10 awards in FY 1988.

MEASUREMENT AND MONITORING TECHNIQUES DEVELOPMENT

Future monitoring and measurement technology efforts will include:

- Development and demonstration of immunoassay and fiber optic sensor technology.
- Identification of private entities which have monitoring technologies to demonstrate, specifically for monitoring in the saturated and vadose zones.
- Consideration of identified technologies that can be used to determine the physical and chemical character of contaminants.
- Consideration of identified technologies that can be used to measure and monitor the stresses imposed by contaminants on complex ecosystems at Superfund sites.
- Coordination with other ORD laboratories to identify existing and planned research which may be useful for environmental monitoring at Superfund sites and considered under the SITE Program.

Immunoassay research plans for FY 1988 include:

- Evaluation of monoclonal antibody-based immunoassays for benzene, ethylbenzene, toluene, and phenol.
- Continuation of the evaluation of the immunoassay for pentachlorophenol initiated in FY 1987.
- Depending on the results of the above evaluation, demonstration of the pentachlorophenol immunoassay at a Superfund site.
- Compilation of a list of EPA priority compounds for potential immunoassay applications.
- Investigation of currently available standard delivery systems to determine potential use for Agency monitoring activities.

Plans for fiber optics research include developing it for aqueous phase measurements in order to extend its application to in situ groundwater monitoring. With adequate improvements in sensitivity, other potential applications for the chloroform sensor would be monitoring trihalomethanes in drinking water.

Other FY 1988 goals include the development of several compound-specific sensors, for compounds such as gasoline, aviation gasoline (JP-4), and trichloroethylene.

The laboratory intends to integrate its immunoassay techniques with the ongoing fiber optics research. Applying these tools jointly in Superfund site assessment will serve as a means to cross check and validate data generated by each method.

INNOVATIVE DEVELOPMENT AND EVALUATION PROGRAM

Over the past few years, EPA's office of Research and Development has been developing alternative technologies for the destruction and cleanup of hazardous waste. These efforts complement the SITE program. Several of these technologies are approaching the field evaluation and demonstration stage and research on these technologies has progressed to a point where regional requests have been received to apply these technologies to Superfund wastes. After the technologies are satisfactorily demonstrated on these Superfund wastes, it is expected that technologies will be commercialized and marketed by private industry. The Technology Transfer Act of 1986 simplifies the government-industry partnership necessary to bring these in house technologies to market. It is expected that market risk will be reduced and development accelerated by conducting field evaluations and, in some cases, field demonstrations under the SITE program. The SITE Program will also actively disseminate information concerning these technologies. Some of these technologies are discussed below.

EPA Mobile Incinerator System

The mobile incinerator consists of specialized equipment mounted on four trailers. The first trailer contains the rotary kiln, in which organic wastes are vaporized and partially oxidized at approximately 1800°F with a nominal retention time up to 60 minutes. Incombustible treated soil/ash is discharged directly from the kiln. The volatile organic compounds or gases from the primary unit or first trailer pass through the secondary combustion chamber (SCC) in the second trailer, where oxidation is completed at a temperature of 2200-2400°F and a retention time of 2.2 seconds. The flue gas exits from the SCC and is cooled from 2200°F to approximately 190°F by a venturi quench elbow. The gases then pass into air pollution control equipment on the third trailer. There, submicron- sized particulates are removed by a wet electrostatic precipitator, and byproduct acid gases are neutralized in an alkaline scrubber. Gases are drawn through the system by an induced draft fan, which maintains an overall vacuum to ensure that no toxic gases escape from the system. The cleaned gases are discharged from the system through a 40 foot high stack. The incinerator can process 9,000 pounds of contaminated soil or 75 gallons of liquid per hour.

System performance is monitored through instruments and automatic safety shutdown controls. Additionally, the system is manually monitored and thus can be shut down by an operator.

Upon request from EPA Region VII, the Mobile Incineration System (MIS) was transported to the James Denney Farm site in McDowell, Missouri, in 1985. The MIS demonstrated a greater than 99.9999% destruction and removal efficiency (DRE) at a trial burn on liquids and solids contaminated with dioxins and has been operated over the past two years for cleanup of dioxin-contaminated liquids and soils at the site and from numerous other dioxin sites in southwest Missouri. To date, over 2 million pounds of solids and 18,000 gallons of liquids have been processed.

The unit is currently processing the remainder of the dioxin-contaminated materials at the Denney Farm site and may soon be processing EPA's office of Pesticide Programs cancelled pesticides, including 2,4,5-T/Silvex liquids and solids.

EPA Mobile Soils Washing System

The Mobile Soils Washing System has been designed for the extraction of a broad range of hazardous materials from spill-contaminated soils using water as the extraction solvent. The system will: 1) treat excavated contaminated

soils, 2) return the treated soil to the site and 3) separate the extracted hazardous materials from the washing fluid for further processing and/or disposal. The prototype has been developed utilizing conventional equipment for screening, size reduction, washing, and dewatering of the soils. The washing-fluid water may contain additives, such as acids, alkalies, detergents, and selected organic solvents to enhance soil decontamination. The nominal processing rate is 4 yd^3/hr of contaminated soil for soil particles less than 2 mm in size, and up to 18 yd^3/hr for soil of larger particle size.

EPA Mobile Carbon Regeneration System

The Mobile Carbon Regeneration System was designed for field use in reactivating spent granular activated carbon used in spill or waste site cleanup operations. Using the process of adsorption in which the molecules of one substance adhere to the surface of another, the mobile carbon regenerator provides an important means of removing dissolved organic hazardous material from water. When contaminated granular activated carbon (GAC) is heated in the kiln, organic substances are desorbed and volatilized. All vapors and gases from the kiln flow through a duct into the secondary combustion chamber where an excess oxygen level is maintained. Temperature and residence time are controlled to assure desorption/detoxification of hazardous organic substances, including chlorinated hydrocarbons. off-gases are water-quenched and scrubbed with an alkaline solution before being vented to the atmosphere. Stack gases and used process water are monitored.

KPEG Chemical Detoxification

The KPEG process has been developed as a method to dechlorinate toxic organochlorine compounds, i.e., PCBs, dioxins, and furans. In the process, potassium hydroxide reacts with polyethylene glycol to form an alkoxide. The alkoxide in turn reacts initially with one of the chlorine atoms on the aryl ring to produce an ether and potassium chloride salt. In some KPEG reagent formulations, dimethylsulfoxide (DMSO) is added as a cosolvent to enhance reaction rate kinetics.

The mobile field equipment comprises a 2,700-gallon batch reactor mounted on a 45-foot trailer equipped with a boiler and cooling system and a laboratory control room area.

The KPEG process has been used to detoxify wastes generated at a wood- treating site in Butte, Montana. This waste was generated as an oily phase of groundwater and, after separation by decantation, contained approximately 3% pentachlorophenol (PCP) in a diesel-like oil. The PCP-oil waste contained homologs of chlorinated dibenzodioxins (CDDs) and chlorinated dibenzofurans (CDFs) ranging from 147 ppb of tetra- to 84,000 ppb of the octa-congeners. The data indicate that after processing, all CDDs and CDFs were destroyed to concentrations below detection limits, which were, on the average, less than 1 ppb.

In another application, the equipment was transported to a Superfund site in Kent, Washington, where it successfully processed 7,550 gallons spent solvent containing an oily waste with a high moisture content (28%), total chlorides of 20,700 mg/1, and a 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD) content of 120 ppb. No 2,3,7,8-TCDD was detected at levels higher than the detection limit of 0.3 ppb in any of the processed batches.

More recently, a 40-gallon reactor was evaluated on PCB-contaminated liquids and soils at the General Electric Moreau site in Glens Falls, New York. As a result, a 2.1 yd^3 reactor was constructed and will be tested in January 1988 at the U.S. Navy Public Work Center in Guam on soil and sludge contaminated with PCBs, ranging from 2000 to 4500 ppm. This testing is a cooperative effort between EPA and the U.S. Navy. Following successful testing of the KPEG reactor in Guam, the unit will be further tested and evaluated at the Wide Beach, New York, PCB Superfundsite and eventually will be used to treat PCB- contaminated oil and soil in Butte, Montana.

TECHNOLOGY TRANSFER/ CLEARINGHOUSE

Over the next several years, the SITE technology transfer program will move increasingly toward immediate access to information by telephone or computer linkage. Users will be able to obtain answers to questions concerning alternative technologies by telephone or via computer hookup with EPAdatabases. The information available will include up-to-date status reports on individual SITE projects and final reports on those that have been completed, information on other alternative technologies, and information on relevant conferences and publications.

A major focus of Clearinghouse activities in 1988 will be outreach to potential users. A brochure describing the Clearinghouse will be mailed to potential users. In addition, EPA will implement a feedback system to ensure that the information provided by the Clearinghouse meets users' needs, is timely, and is accurate.

• U.S. GOVERNMENT PRINTING OFFICE: 1988 549-010/80018